



Florida Department of Transportation

Florida's Turnpike Enterprise

ELECTRICAL GUIDE SPECIFICATIONS

(TPPPH Version)

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Electrical Guide Specifications INTRODUCTION

These Guide Specifications are intended to support the various engineering obligations for designing, specifying, estimating, constructing, inspecting, testing, accepting, operating, and maintaining electrical plant in Florida's Turnpike Enterprise Toll Facilities. They are prepared to encourage uniform application of standard policies and designs in the preparation of construction documents and to reduce errors that consume review time. The Guide Specifications are not intended to be a medium for duplication. It is the responsibility of the Design Engineer of Record for a particular project to determine the appropriateness and applicability of the Guide Specifications in the design of that project. Project specific conditions will exist where certain Guide Specifications "as is" are not appropriate and do not apply. The Design Engineer of Record for the project is responsible for identifying these conditions and for providing an appropriate design. Use of these Guide Specifications does not relieve the designer and professional engineer from following safe practices or exercising proper engineering judgment in the design process.

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Contractual Conditions apply to this section.

1.2 WORK INCLUDED

- A. This section includes Basic Electrical Requirements specifically applicable to Division 26 Sections.
- B. Furnish, perform, or provide all materials and labor including the planning, purchasing, transporting, storing, installing, testing, cutting, patching, trenching, excavating, backfilling, coordination, field verification, and miscellaneous materials necessary for the installation of complete electrical systems as described or implied by these specifications and the applicable drawings.
- C. All systems, equipment, materials and accessories that are assembled or installed for the project shall comply with the:
 - 1. Florida Building Code, 2007 Edition with 2009 Supplements
 - 2. Florida Fire Prevention Code and the publications as referenced in NFPA 1 – Uniform Fire Code (the Florida 2006 Edition) and NFPA 101 – Life Safety Code (the Florida 2006 Edition).
- D. Field install Arc Flash and Shock Warning labels on each piece of new electrical distribution equipment such as panel boards, safety switches, motor control centers, and automatic transfer switches. The labels will indicate the flash hazard boundary, the flash hazard at 18 inches, the PPE level requirements, and the approach restrictions.
- E. Coordinate and verify power and telephone company service requirements prior to material procurement and installation of service equipment.
- F. Provide labor and materials for electrical connections and wiring to all items in the contract documents which require electric power.
- G. Secure and pay for all permits, fees, licenses, and inspections required to perform Division 26 work.
- H. Provide a temporary 100 Amp electrical service, 20 Amp GFCI protected receptacles for portable tools, and temporary lighting in the building (20 foot

candles average), for use during construction. Take responsibility to pay for all electrical power during construction.

1.3 DEFINITIONS

- A. Provide: Furnish, install, and connect complete.
- B. Review of shop drawings: A service by the Engineer to reduce the possibility of materials being ordered which do not comply with Contract Documents. The Engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. When an error is not detected, this does not grant the Contractor permission to proceed in error.
- C. Wiring: Wire and cable, installed in raceway with boxes, fittings, connectors, supports, accessories, overcurrent protection, and disconnects per applicable codes.
- D. Work: Materials completely installed.
- E. Connect: Provide all wiring and connections required for a properly operating system.

1.4 WORK SEQUENCE

- A. Coordinate with the General Contractor for phasing. Renovation projects require the existing building and electrical systems to remain operational while the renovation work takes place.

1.5 DESCRIPTION

- A. Install the equipment in locations shown or described in the Contract Documents, unless prevented by Project conditions.
- B. Install all equipment such that all Code and Manufacturer recommended working and clearances are maintained. Properly arrange and install all equipment within designated spaces. If a departure from the Contract Documents is necessary, submit to the Engineer for approval, detailed drawings of the proposed changes with written reasons for the changes. No change shall be implemented without approval as permitted by the General Conditions.
- C. Verify finish dimensions at the project site in preference to using dimensions noted on Contract Documents.
- D. Branch circuits shall be designed and installed such that the worst case voltage drop at the end of a fully loaded circuit, operating at 0.8 pf lagging, does not

exceed 3% voltage drop, measured line to neutral. Feeder circuits shall be designed and installed such that the worst case voltage drop at the end of a fully loaded circuit, operating at 0.8 pf lagging, does not exceed 2% voltage drop, measured line to line.

1.6 INVESTIGATION OF SITE

- A. In accordance with Article 2-4 FDOT Specifications, investigate the site and existing conditions thoroughly before bidding.
- B. During the course of a site visit, the electrical bidder shall become familiar with all aspects of the proposed work and existing field conditions of the work. No compensation or reimbursement for additional expenses for failure investigate the existing facilities will be authorized. This shall include rerouting around existing obstructions. Submission of a proposal will be construed as evidence that such examination has been made and later claims for labor, equipment or materials required because of difficulties encountered will not be recognized.
- C. Existing sizes, conditions and utilities indicated are taken from record documents, existing construction documents, and field surveys. Unforeseen conditions probably exist and the existing conditions shown on drawings may differ from the actual existing installation.
- D. Become familiar with all existing conditions prior to bidding, and include in the bid the removal of all electrical equipment, wire, conduit, devices, fixtures, etc. that is to be demolished..
- E. Occupied existing buildings must remain in operation while the new work is being performed. Schedule work for a minimum outage to the Department. Reroute existing conduit and wiring in areas under construction such that the building systems remain active and useable for the building occupants. Notify the Project Manager 48 hours before any shut-down of existing systems.

1.7 CONTRACT DOCUMENTS

- A. The drawings are diagrammatic and are not intended to include every detail of construction, materials, methods, and equipment. They indicate the result to be achieved by an assemblage of various systems. Coordinate equipment locations with the Civil, Architectural, Structural, Mechanical, and Plumbing trades. Layout the equipment before installation so that all trades may install equipment in the spaces available.
- B. Should conflicts exist between the Drawings and Specifications, take responsibility to ask for clarification prior to performing the work.

- C. Refer to the Architectural plans for dimensions, and fit the work to conform to the details of the building construction. The right is reserved to shift any switch, receptacle, ceiling outlet or any special outlet a maximum of 10'-0" from its location as shown before it is permanently installed, without incurring additions to the contract.
- D. Wiring arrangements for equipment shown on the drawings are intended to be diagrammatic and do not show all required conductors and functional connections. Provide all items to form a complete and operating system.
- E. Submit specific shop drawings which indicate the fabrication, assembly, installation, and erection of particular systems' components. Drawings that are part of the Contract Documents shall not be considered a substitute for required shop drawings, field installation drawings, code requirements, or applicable standards.
- F. Locations indicated for outlets, switches, and equipment are approximate and shall be coordinated with the Contract Documents and other trades. Where instructions or notes are insufficient to locate the item, ask for clarification from the Engineer.

1.8 MATERIALS AND EQUIPMENT

- A. Unless otherwise noted, all material shall be new and U.L. listed or labeled. In lieu of UL listing or labeling, a statement or data demonstrating compliance with contract documents from a nationally recognized testing agency shall be submitted for approval.
- B. Where Contract Documents list design selection or manufacturer, type, this model shall set the standard of quality and performance required. Where no brand name is specified, the source and quality shall be subject to the Engineer's review and approval.
- C. When a product is specified to be in accordance with a trade association or government standard and at the request of the Engineer furnish a certificate that the product complies with the referenced standard and supporting test data to substantiate compliance.
- D. Where multiple items of the same equipment or materials are required, they shall be the product of the same Manufacturer.
- E. Prior to placing equipment orders, verify that the physical dimensions of the equipment will allow for proper installation in the space allotted on the drawings and with NEC working clearances.

- F. Electrical equipment shall be protected from the weather during shipment, storage, and construction per the manufacturer's recommendations. Should any equipment be subjected to damage by water, it shall be replaced without additional cost to the Department.
- G. Inspect all electrical equipment and materials prior to installation. Damaged equipment and materials shall not be installed or placed in service. Replace or repair the damaged equipment (in compliance with industry standards) at no additional cost to the Department. Any equipment and/or testing required for the repairs shall be provided by the Contractor.
- H. Material and equipment shall be provided complete and shall function up to the specified capacity or function. Should any material or equipment, as a part or as a whole, fail to meet the performance requirements, the material or equipment shall be replaced or repaired to bring the performance up to the specified requirements. Damages to the finish or the paint by such replacements, alterations, or repairs shall be restored to prior conditions, at no additional cost to the Department.
- I. Where tamper proof screws are specified or required, Phillips head or Allen head screws are not acceptable as tamperproof. For each size or type used, provide the Department with three tools. If existing tamper proof equipment exists on the job site, the screw heads shall match the existing.
- J. Communications backboards shall be 3/4" B/C grade, Class A, flame spread, painted with light gray fire retardant paint. Neatly mask off a minimum of one (1) plywood Manufacturer's pre-printed certified fire rating stamp per section of board prior to application of paint. Remove masking after paint has cured.

1.9 SUPERVISION OF THE WORK

- A. Reference the General Conditions for additional requirements.
- B. A qualified and experienced electrical superintendent shall be in charge of the work in progress at all times. If, in the judgment of the Department's representative, the electrical superintendent is not performing duties satisfactorily, the General Contractor shall immediately replace him upon receipt of a letter of request from the Department. Once a satisfactory electrical superintendent has been assigned to the work, he shall not be withdrawn by the Electrical Contractor without the written consent from the Department.
- C. Provide field superintendent(s) who have a minimum of four years previous successful experience on projects of comparable sizes and complexity. Superintendent shall be present at all times that work under this Division is being installed or affected. All work performed by a non-licensed Journeyman shall be under the direct supervision (in the presence of) of a Licensed Journeyman as specified herein. Increase the quantity of licensed Journeymen as required for

supervision of all areas where direct contact is not possible. At least one member of the electrical contracting firm shall hold a State Master Certificate of Competency.

1.10 COORDINATION

- A. Provide all required coordination and supervision where work connects to, or is affected by the work of others, and comply with all requirements affecting this Division. Work required under other divisions, specifications or drawings to be performed by this Division shall be coordinated with the Contractor and such work performed at no additional cost to the Department including but not limited to electrical work required for:
 - 1. Door hardware
 - 2. Roll-up doors
 - 3. Roll-up grilles
 - 4. Signage
 - 5. Fire shutters
 - 6. Elevators
 - 7. Sliding doors
 - 8. Mechanical Division of the Specifications
 - 9. Landscape Architect drawings
 - 10. Lifts
 - 11. Kitchen equipment
 - 12. Conveyors
 - 13. Interior design drawings
 - 14. Millwork design drawings and shop drawings
- B. Installation studies shall be made to coordinate the electrical work with other trades. Work shall be preplanned. Unresolved conflicts shall be referred to the G.C. prior to installation of the equipment.
- C. Scaled coordination drawings (1/2" = 1') shall be prepared by the Electrical Contractor and submitted with the engineering shop drawings for review and approval by the engineer prior to the start of work. Drawings shall show the actual physical dimensions required for the installation to assure proper integration of the equipment with building systems and NEC required clearances. Locations of conduit racking, etc., shall be provided. Coordination drawings shall be provided for all areas and rooms where electrical switchboards, panelboards, and transformers are installed.
- D. Secure approved shop drawings from all required disciplines and verify final electrical characteristics before roughing in the power feeds to any equipment. When electrical data on approved shop drawings differs from that shown or called

for in the Construction Documents, make adjustments to the wiring, disconnects, and branch circuit protection to match that required for the equipment installed.

- E. Damage from interference caused by inadequate coordination shall be corrected at no additional cost to the Department.
- F. Coordinate the exact location of floor outlets, floor ducts, floor stub-ups, etc. with the General Contractor (and receive their approval) prior to rough-in. Locations indicated in Contract Documents are only approximate locations.
- G. The Contract Documents describe specific sizes of switches, breakers, fuses, conduits, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). Coordinate the requirements of each load with each load's respective circuitry shown and with each load's requirements as noted on its nameplate data and manufacturer's published electrical criteria. Adjust circuit breaker, fuse, conduit, and conductor sizes to meet the actual requirements of the equipment being provided and installed and change from single point to multiple points of connection (or vice versa) to meet equipment requirements. Changes shall be made at no additional cost to the Department.

1.11 PROVISION FOR OPENINGS

- A. Locate openings required for work. Provide sleeves, guards or other approved methods to allow passage of items installed.
- B. Coordinate with roofing Contractor on installation of electrical items which penetrate the roof. Roof penetrations shall be installed so as to not void the roof warranty.
- C. Where work pierces any waterproofing, it shall maintain the integrity of the waterproofing. Coordinate the work which pierces the waterproof barrier with the General Contractor.

1.12 CONCRETE PADS

- A. Furnish and install reinforced concrete housekeeping pads for transformers, switchgear, generators, motor control centers, and other free-standing equipment installed within the building. Unless otherwise noted, pads shall be four (4) inches high and shall exceed dimensions of equipment being set on them, including future sections, by six (6) inches each side, except when equipment is flush against a wall where the side against the wall shall be flush with the equipment. Pads shall be reinforced with W1.4 x 1.4 6 x 6 welded wire mesh. Chamfer top edges 1/2". Trowel all surfaces smooth. Provide 3000 psi concrete.

- B. Refer to Civil & Structural plans for the requirements of outdoor concrete pads supporting transformers, switchgear, generators, motor control centers, and other free-standing equipment. Coordinate pad installation, dimensions, conduit windows, or stub-ups with approved equipment shop drawings.

1.13 SURFACE MOUNTED EQUIPMENT

- A. Surface mounted fixtures, outlets, cabinets, conduit, panels, etc. shall have a factory finish or shall be painted as directed by designer. Paint shall be in accordance with applicable sections and/or divisions of these specifications.

1.14 CUTTING AND PATCHING

- A. Reference Division 1 - General Requirements.
 - 1. Provide cutting and patching necessary for the installation of Division 26 work.
 - 2. Cutting of work in place shall be cut, drilled, patched and refinished to match specified finish.
 - 3. Backfill new grades to match adjacent undisturbed surface.
 - 4. Schedule work to place Division 26 work to avoid as much cutting and patching as practical.

1.15 TRENCHING AND BACKFILLING

- A. All trenching, backfilling and compaction requirements shall be in accordance with other sections of these specifications.
- B. Trench excavation in excess of 5 feet deep shall comply with OSHA Standard 29 C.F.R.s. 1926. 650 Subpart P.

1.16 DELIVERY, HANDLING, PROTECTION OF MATERIALS, AND STORAGE

- A. Ship, deliver, and store products in the manufacturer's protective packing to prevent damaging.
- B. Handle equipment carefully to prevent damage to components, breakage and denting or scoring of surfaces and finishes.
- C. Store all equipment and products in clean, dry spaces. Protect all equipment from dirt, fumes, water, chemicals, construction debris and physical damage. Any equipment exposed directly to moisture will not be acceptable and shall be replaced.

- D. Replace damaged products and equipment. Repair and repaint marred and damaged finishes to original factory finish as directed by manufacturer and as herein specified.
- E. Keep all conduits and other openings protected against entry of foreign matter.

1.17 INSTALLATION

- A. Listed or Labeled Equipment shall be installed and used in accordance with any instructions included in the listing or labeling.
- B. Erect equipment to minimize interference and delays with the execution of the Work.
- C. Take care in erection and installation of equipment and materials to avoid marring finishes or surfaces. Any damage shall be repaired or replaced as determined by the Department at no additional cost to the Department.
- D. Equipment requiring electrical service shall not be energized or placed in service until the G.C. is notified and is present or have waived their right to be present. Where equipment to be placed in service involves service or connection from another Contractor, notify the G.C. in writing as appropriate when the equipment will be ready.
- E. Equipment supports shall be secured and supported from structural members unless written approval is granted by the Engineer.
- F. Plywood material shall not be used as a backboard for mounting panel boards, disconnects, motor starters, and dry type transformers. Provide "cast in place" type inserts or install expansion type anchor bolts. Electrical equipment shall not be mounted directly to dry wall for support without additional channels as anchors. Channels shall be anchored to the floor and structure above. Panelboards and terminal cabinets shall be provided with structural framing located within drywall partitions.
- G. Inserts, pipe sleeves, supports, and anchorage of electrical equipment shall be provided. Where items are to be set or embedded in concrete or masonry, the items shall be furnished and layout made for setting or embedment thereof so as to cause no delay.

1.18 PRODUCT SUBSTITUTIONS

- A. The Contract for construction shall be based upon products and standards established in the Contract Documents.
 - 1. Product substitutions shall only be considered if:

- a. Substituted product meets the design intent and quality of the specified project.
- b. All requirements of Section 260502 are met and the substitution is approved by the Engineer.
- 2. Approval of substitutions is at the Engineer's sole discretion. If substitutions are rejected by the Engineer, the Contractor shall submit specified products.

1.19 AS-BUILT DOCUMENTS

- A. As-Built Documents: As-built Documents include Drawings, Shop Drawings, Specifications, Addenda, Change Orders, and other modifications permitted by the General Conditions.
- B. Verify aspects of redlined as-builts for accuracy. As-Built Documents shall show all components including but not limited to:
 - 1. All raceways 1-1/4" and above, cable tray systems, and grouped raceway racking as installed, including dimensions from fixed building lines such as column lines.
 - 2. All site underground raceways and duct banks indicating burial depths and distances from fixed building lines or global tracking coordinates.
 - 3. Underground pull boxes and manholes including elevations. Detail manhole and pull boxes, conduit terminations (butterfly layout) including conduit sizes, designated systems and cabling description.
 - 4. General conduit routing from receptacle to receptacle, fixture to fixture, device to device. (Exact routing is not required for raceways 1" and smaller.)
 - 5. Lighting.
 - 6. The first junction box within each homerun, regardless of size shall be shown in the installed location.
 - 7. All junction boxes and pull boxes located above non-accessible ceilings shall be shown in exact location. All junction boxes 6"X6" and larger shall be shown in exact location.
 - 8. Any combining of circuits (which is only allowed by specific permission) or change in homerun outlet box shall be indicated.
 - 9. Any circuit number changes.
 - 10. All conductors and cables, conductors and cable sizes, raceway sizes, etc not shown on contract documents and any changes from the documents.
 - 11. Any switchboard, panelboard, motor control center, relay panel, or dimming control panel schedule changes, including load changes.
 - 12. All access panels.
 - 13. All existing conditions.
 - 14. Location of lighting control devices such as photocell controls, space occupancy sensors, etc.

15. Exact quantity of conductors and cables shall be shown for all raceway systems.
 16. All devices, wall outlet boxes, and control components.
 17. All wireway and cable tray systems.
 18. Exact location of all driven grounding electrodes including burial depths and dimensions from fixed building lines. Location of all grounding and lightning protection ground loops.
 19. All building automation system (BAS) control panels and associated electrical devices, connections, power supplies, and dampers.
 20. Riser diagrams exactly as installed.
 21. Switchboard, panelboards, motor control center, motor control devices, terminal cabinets, equipment racks, relays, disconnects and switches and surge protection devices.
 22. Change the equipment schedules (i.e. symbol legends, light fixture schedule, etc) to agree with items actually furnished.
 23. Change plan notes to agree with items actually furnished, actual installation methods, etc. respectfully.
 24. Cross-out all items, circuitry, devices, etc. not applicable.
- C. As-Built red line information shall not compromise the clarity of the Contract Documents and Shop Drawings. Major components such as grouped raceway assemblies, cable tray systems, larger conduits, duct banks, racking, elevations, dimensions, etc. shall be shown on a clean architectural base plan(s) separate from the Contract Electrical Documents, as required to clearly delineate work. Obtain electronic base plan file from the Architect.

1.20 SYSTEMS WARRANTY

- A. Reference the General Conditions.
- B. The Warranty shall be provided by the Contractor to the Department and shall cover Labor and Materials for a period of one year from the date of the Substantial Completion. The Warranty shall not include light bulbs in service after one month from date of substantial completion of the System.
 1. Explain the provisions of warranty to the Department at the "Demonstration of Completed System" meeting to be scheduled with the Department upon project completion.
- C. Where equipment or materials carry a manufacturer's warranty for a period in excess of twelve (12) months, then the manufacturer's warranty shall apply to that particular piece of equipment or material.
- D. Where extended Warranties or Guarantees are called for herein, furnish three copies to be inserted in the Operation and Maintenance Manuals.

- E. All preventative maintenance and normal service will be performed by the Department's maintenance personnel after final acceptance. This shall not alter the Contractor's 1 year warranty or the manufacturer's warranty of the installed equipment.

1.21 WASTE MATERIALS DISPOSAL

- A. Include in base bid the transport and disposal or recycling of all waste materials generated by this project in accordance with all rules, regulations and guidelines applicable. Comply fully with Florida Statute 403.7186 regarding mercury containing devices and lamps. Lamps, ballasts and other materials shall be transported and disposed of in accordance with all DEP and EPA guidelines applicable at time of disposal. Provide the Department with written certification of approved disposal.

1.22 PROHIBITION OF ASBESTOS AND PCB

- A. Prior to the Final Review field visit the Contractor shall certify in writing that the equipment and materials installed in this Project under this Division 26 contain no asbestos or PCB. Additionally, all manufacturers shall provide a statement with their submittal that indicates that their product contains no asbestos or PCB. This statement shall be signed by a duly authorized agent of the manufacturer.

END OF SECTION 260500

SECTION 260501 – SHOP DRAWINGS AND SUBMITTALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for submittals specifically applicable to Division 26 Sections.
- B. See Section 260502 - Substitutions for additional requirements when submittals consist of substitution equipment.

1.2 SUBMITTAL OF “SUBSTITUTE” EQUIPMENT/PRODUCT

- A. Representation: In submitting item, equipment, product, etc. that has not been listed on contract drawings, in contract documents or in an addenda, Contractor represents that he:
 - 1. Has investigated substitution item and determined that it is equal or superior to specified product in all aspects.
 - 2. Will coordinate installation of accepted substitution into work, making changes as may be required to complete work in all aspects.
 - 3. Waives all Claims for additional costs related to substitution which may subsequently become apparent.
 - 4. Will provide the same warranties for the substitution as for the product specified.
 - 5. Will absorb all costs incurred by the substitution when affecting other trades including but not limited to electrical, mechanical, structural, architectural, civil, etc.
 - 6. Will absorb any cost incurred by the Engineer in review of the substituted product if the acceptance of the substituted item creates the need for system modification and/or redesign, or if the substituting contractor exhibits negligence in his substituting procedure thus submitting inferior, misapplied or mis-sized equipment. In the event of additional engineering costs the billing structure shall be agreed upon prior to review by all involved parties.

1.3 SUBMITTAL BROCHURES TO INCLUDE

- A. The first sheet shall list the project title and contractor information. The list shall include subcontractors, contact names, telephone numbers, and fax numbers (see form included at end of this section).
- B. Submit information on each specification section in the Index. Provide separate “pdf” documents for each section of the index. Submit all sections at the same time to facilitate a proper review and cross checking between sections.
- C. Submittals consisting of marked catalog sheets and/or shop drawings shall be provided in electronic “pdf” format. Submittal product data shall be presented in a clear and thorough manner. Clearly mark each sheet to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Markings shall be made with arrows, circles or underlining. (Highlighting is not acceptable.)
- D. Shop Drawings: Drawings shall include identification of project and names of Architect, Engineer, General Contractor, subcontractor and supplier, number the pages sequentially and indicate the following:
 - 1. Fabrication and erection dimensions.
 - 2. Arrangements and sectional views.
 - 3. Necessary details, including complete information for making connections with other work.
 - 4. Kinds of materials and finishes.
 - 5. Descriptive names of equipment.
 - 6. Modifications and options to standard equipment required by the work.
 - 7. Leave blank area, size approximately 4 by 2 1/2 inches, near title block (for A/E’s stamp imprint).
 - 8. In order to facilitate review of drawings, they shall be clearly noted, indicating by cross reference the contract drawings, note, and specification paragraph numbers where items occur in the Contract Documents.
 - 9. Conduit/raceway rough-in drawings.
 - 10. Items requiring shop drawings include (but not limited to):

- a. Each section of 270000 and 280000 broad section (i.e. fire alarm, CCTV, Access Control, etc.).
- b. Special and/or modified equipment.
- c. U.L. listed fire and smoke stopping assemblies for each applicable penetration.
- d. Lighting controls and lighting control panels
- e. Electrical room, layout plans, ½ inch = 1ft scale.
- f. Interconnection diagram for engine generator equipment and accessories.

11. See specific sections of specifications for further requirements.

E. Product Data: Technical product data is required for all items as called for in the specifications regardless if item furnished is as specified.

- 1. Submit technical data verifying that the item submitted complies with the requirements of the specifications. Technical data shall include manufacturer's name and model number, dimensions, weights, electrical characteristics, and clearances required. Indicate all optional equipment and changes from the standard item as called for in the specifications. Furnish drawings, or diagrams, dimensioned and in correct scale, covering equipment, showing arrangement of components and overall coordination.
- 2. In order to facilitate review of product data, they shall be clearly annotated, indicating by cross reference the contract drawings, note, and/or specification paragraph numbers where and/or what item(s) are used for and where item(s) occur in the contract documents. Identify product data as to the item and/or location (i.e. "surge suppression switchboard MDP").
- 3. See specific sections of the specifications for further requirements.
- 4. Re-Submit any and all technical data rejected by the Engineer of Record or the Turnpike Enterprise.

1.4 PROCESSING SUBMITTALS

- A. Florida's Turnpike Enterprise (FTE) Shop Drawing Processing Group assists Construction, Facilities/Maintenance and Traffic Operations (ITS) by processing Shop Drawings for all projects under construction. The Shop Drawing Processing Group coordinates review time with the Engineer of Record/Architect of Record and the Turnpike internal reviewers, to assist in a prompt turnaround time.
- B. Turnpike Enterprise processes shop drawings "Electronically" through a web-based site, **ProjectSolve**, <https://ww2.projectsolve2.com>. Processed shop

drawings are also stored on this website, once the project has reached completion; they are downloaded in the FDOT EDMS System for future reference.

- C. The FDOT Plans Preparation Manual allows 45 days for reviewing shop drawings and 30 days for resubmittals. The Shop Drawing Processing Group attends partnering sessions to establish an agreement with reviewing parties for a three week total turnaround time for Shop Drawings. In the agreement we establish 1.5 weeks for the EOR (Engineer of Record)/AOR (Architect of Record) and 1.5 weeks for the Turnpike reviewers.

1.5 SHOP DRAWING STANDARDS

- A. Refer to Chapters 28, Volume 1 of the FDOT Plans Preparation Manual (PPM) and Turnpike Plans Preparation and Practice Handbook (TPPPH) located at:
http://design.floridasturnpike.com/prod_design/shopdrawings/shopdrawings.html

1.6 DELAYS

- A. Contractor is responsible for delays in job project accruing directly or indirectly from late submissions or resubmissions of shop drawings, or product data.

1.7 RESUBMITTALS

- A. The Architects & Engineers shall be reimbursed for costs to review resubmittals subsequent to the second submittal. Cost will be billed to the contractor at the engineer's standard hourly rate.

“EXAMPLE PAGE 1”

ELECTRICAL SYSTEM SHOP DRAWING AND BROCHURES

SECTION 260526 - GROUNDING

FLORIDA’S TURNPIKE ENTERPRISE

XYZ TOLL PLAZA

FPID #515462-2-62-01

ORLANDO, FLORIDA

ARCHITECT:

ENGINEER:

GENERAL CONTRACTOR:

SUBCONTRACTOR:
(Provide list of all subcontractors)

END OF SECTION 260501

SECTION 260502 - SUBSTITUTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section specifies general, administrative and procedural requirements for substitutions for Division 26 sections.
- B. Request for substitutions must be submitted within 30 days of the award of the contract.

1.2 DEFINITIONS

- A. Definitions used in this article are not intended to change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Products, materials, equipment, finishes, and methods of construction are considered substitutions if they meet any one of the following conditions:
 - 1. Does not meet all the requirements of these specifications under Part 1 - General or Part 2 - Products for any section included in Division 26 - Electrical Specifications.
 - 2. Is not the specified manufacturer and/or model which accomplishes the same result as that design specified in Division 26 - Electrical Specifications.
 - 3. Is of similar or different design that:
 - a. Requires more space.
 - b. Requires more power.
 - c. Requires changes in other elements of the work such as (but not limited to) architectural, mechanical, structural, or other electrical work.
 - d. Affects the Construction schedule.

1.3 REQUEST FOR SUBSTITUTION SUBMITTALS

- A. A separate requests for substitutions shall be submitted for each product, material, etc. that is defined as a substitution.

- B. Submittal must consist of written request for substitution with date as required below. Request must be very specific as to what specified item, request for substitution is submitted for.
- C. Each request for substitution submittal for each product, etc. shall include:
 - 1. Name of material or equipment for which it is to be substituted.
 - 2. Drawings, product data, performance data and/or other information necessary for the engineer to determine that the equipment meets all specifications and requirements.
 - 3. Compliance statement. Each request shall include the following compliance statement typed on letterhead of submitting company:
 - a. Submittal complies with all aspects/requirements of contract documents: (Y/N) If no, state deviances:
 - b. Submittal complies with all applicable codes: (Y/N) If no, state deviances:
 - c. Submittal does not require change to any other element of the work: (Y/N) If no, state required change:
 - d. Meets or exceeds the performance of specified product: (Y/N) If no, state required change:

1.4 CONSIDERATION AND ACCEPTANCE

- A. Request for substitutions will not be considered if:
 - 1. Submittal does not comply with all requirements as noted above or contain all information required above.
 - 2. If submittal does not contain compliance statement, fully filled out.
 - 3. If compliance statement contains a 'no' or 'N'.
 - 4. Submittals are submitted beyond time limitations noted above.
- B. Samples
 - 1. Sample may be required to be submitted, if deemed necessary by the A/E to determine if the substitution meets specifications.
 - 2. The A/E reserves the right to reject sample and consequently the substitution should the sample not meet the requirement of the contract documents.

- C. Substitutions will be considered on basis of design, concept of work, and overall conformance with information given in Contract Documents, including but not limited to:
 - 1. Design criteria, which shall be equal or superior to the specified item.
 - 2. Finishes, which shall be identical or superior to finishes of specified product.
 - 3. Lenses or louvers, which shall be identical size, thickness and type material specified.
 - 4. Physical size and dimension which are identical or within design criteria limitations as determined by the Engineer.
 - 5. Photometric data, which shall be identical or superior in quantity and quality.
 - 6. Trim detail, electrical, and mechanical qualities, shall be identical or within design criteria limitations as determined by the Engineer.
- D. The Engineer's decision on acceptance or rejection of substitutions will be final.
- E. Approval of a substituted item or listing a substituted item as an approved substitution does not modify or act as a waiver in any way, of the requirements of the contract documents. See Section 260501 for additional requirements on approved substitution submittals, equipment, etc.
- F. The naming of any manufacturer as an approved substitution does not imply automatic approval as a substitution. It is the sole responsibility of the Contractor to ensure that any price quotations received and submittals made are for systems that meet or exceed these specifications.

END OF SECTION 260502

SECTION 260503 REFERENCE STANDARDS AND REGULATORY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reference Standards and Regulatory Requirements specifically applicable to Division 26 sections.
- B. The requirements stated herein are in addition to Division 01 - General Requirements and any supplemental requirements/conditions.

1.2 REFERENCES

- A. The following references may or may not be referenced within these specifications:

- 1. ADA Americans with Disabilities Act
- 2. AHERA Asbestos Hazard Emergency Response Act
- 3. AIA American Institute of Architects
1735 New York Avenue, NW
Washington, DC 20006
- 4. ANSI American National Standards Institute
1430 Broadway
New York, NY 10018
- 5. ASCE American Society of Civil Engineers
- 6. ASHRAE American Society of Heating, Refrigerating and Air
Conditioning Engineers
1791 Tullie Circle, NE
Atlanta, GA 30329
- 7. ASME American Society of Mechanical Engineers
345 East 47th Street
New York, NY 10017
- 8. ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

9. BICSI BICSI Executive Offices
University of South Florida
Tampa, FL 33620-8700
10. CRSI Concrete Reinforcing Steel Institute
933 Plum Grove Road
Schaumburg, IL 60195
11. DCA-ARM Department of Community Affairs-Accessibility
Requirements Manual
12. DOCA or DCA State of Florida Department of Community Affairs
2740 Center View Drive
Tallahassee, Florida 32399-2100
13. EIA/TIA Electronics Industries
Association/Telecommunications Industry
Association
2001 Pennsylvania Avenue, NW
Washington, DC 20006
14. EJCDC Engineers' Joint Contract Documents Committee
American Consulting Engineers Council
1015 15th Street, NW
Washington, DC 20005
15. FBC Florida Building Code
16. FBCFG Florida Building Code – Fuel Gas
17. FBCM Florida Building Code – Mechanical
18. FBCP Florida Building Code – Plumbing
19. FEMA Federal Emergency Management Agency.
20. FLA. State of Florida
21. FM Factory Mutual System
1151 Boston-Providence Turnpike
P.O. Box 688
Norwood, MA 02062

22.	FPC	Fire Protection Code
23.	IEEE	Institute of Electrical and Electronics Engineers 345 East 47th Street New York, NY 10017
24.	IES	Illumination Engineering Society
25.	ICPEA	International Power Cable Engineer's Association
26.	LPCR	Local Power Company Requirements
27.	LTCR	Local Telephone Company Requirements
28.	NECPA	National Energy Conservation Policy Act
29.	NESC	National Electrical Safety Code (ANSI C2)
30.	NEMA	National Electrical Manufacturers' Association 2101 'L' Street, NW Washington, DC 20037
31.	NFPA	National Fire Protection Association Battery March Park Quincy, MA 02269
32.	OSHA	The Occupational Safety and Health Act
33.	SFM E	State Fire Marshal's Rule on Elevators
34.	SFM FAS	State Fire Marshal's Rule on Fire Alarm Systems
35.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 8224 Old Court House Road Vienna, VA 22180
36.	UL	Underwriters' Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062
37.	ANSI/NFPA 70	National Electrical Code
38.	NFPA 13	Standard for the Installation of Sprinkler Systems

39.	NFPA 30	Flammable and Combustible Liquids Code
40.	NFPA 31	Standard for the Installation of Oil Burning Equipment
41.	NFPA 33	Standard for Spray Application Using Flammable and Combustible Materials
42.	NFPA 69	Standard for Explosion Prevention Systems
43.	NFPA 70	National Electrical Code (NEC)
44.	NFPA 72	Standard for the Installation, Maintenance and Use of Local Protective Signaling Systems
45.	NFPA 75	Standard for the Protection of Electronic Computer/Data Processing Equipment
46.	NFPA 82	Standard for Fire Doors and Windows
47.	NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
48.	NFPA 90B	Standard for the Installation of Warm Air Heating and Air Conditioning Systems
49.	NFPA 91	Standard for the Installation of Exhaust Systems for Air Conveying of Materials
50.	NFPA 92A	Standard for Smoke Control Systems
51.	NFPA 96	Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment
52.	NFPA 101	Life Safety Code
53.	NFPA 105	Standard for Smoke Control Door Assemblies
54.	NFPA 110	Standard for Emergency and Standby Power Systems
55.	NFPA 780	Standard for Lightning Protection
56.	ASTM E136	Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees Fahrenheit

1.3 REGULATORY REQUIREMENTS

- A. Conform to all the applicable requirements of the following codes, standards, guidelines, etc. If there should be conflicting requirements between these codes, standards, guidelines, etc., the more or most stringent requirement shall apply that does not violate any codes or laws. All work shall meet these requirements.
1. Standards and Miscellaneous Codes/Requirements: Comply with latest edition or notice available unless otherwise adopted by Authority having Jurisdiction of the following standards, codes and Regulatory Requirements:
- a. ADA
 - b. ANSI
 - c. ASHRAE
 - d. ASME
 - e. ASTM
 - f. CRSI
 - g. DCA
 - h. EIA/TIA
 - i. FBC
 - j. FBCFG
 - k. FBCM
 - l. FBCP
 - m. FFPC
 - n. IEEE
 - o. IES
 - p. LPCR
 - q. LTCR
 - r. NEC
 - s. NECPA
 - t. NESC
 - u. NEMA
 - v. NFPA Codes and Standards as listed in section 1.2 above
 - w. OSHA
 - x. SMACNA
 - y. UL
 - z. Applicable Florida Statutes and Referenced Codes/Standards.
 - aa. All Federal, State, Local Codes, Laws and Ordinances as applicable.

END OF SECTION 260503

SECTION 260504 - ELECTRICAL SYMBOLS AND ABBREVIATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Symbols and abbreviations specifically applicable to all Division 26 sections in addition to those in Division 01 - General Requirements and any supplemental requirements/conditions.

1.2 SYMBOLS

- A. In general the symbols used on the drawings conform to the Standard Symbols of the Institute of Electrical and Electronic Engineers with the exception of special systems or agencies as hereinafter noted.
 - 1. Corps of Engineers
 - 2. Special Symbols as shown in schedules or legends.
 - 3. FDOT Symbols for roadway lighting or site utilities

1.3 ABBREVIATIONS

- A. The following abbreviations or initials are used.
 - 1. A/C Air Conditioning
 - 2. AFD Adjustable Frequency Drive
 - 3. A.C. Alternating Current
 - 4. A/E Architect/Engineer (or Engineer when Architect not applicable)
 - 5. AFF Above Finished Floor
 - 6. AFG Above Finished Grade
 - 7. AHU Air Handler Unit
 - 8. AIC Ampere Interrupting Capacity
 - 9. AL Aluminum
 - 10. AMP Ampere

- 11. ANSI American National Standards Institute
- 12. AWG American Wire Gauge
- 13. @ At
- 14. B.C. Bare Copper
- 15. BLDG Building
- 16. BRKR Breaker
- 17. BTU British Thermal Unit
- 18. BTUH BTU Per Hour
- 19. C. Conduit
- 20. C.B. Circuit Breaker
- 21. CBM Certified Ballast Manufacturers
- 22. CFM Cubic Feet per Minute
- 23. CKT. Circuit
- 24. C/L Center Line
- 25. Clg. Ceiling
- 26. Comp. Compressor
- 27. Conn. Connection
- 28. Cond. Condenser
- 29. Cont. Continuous
- 30. C.R.I. Color Rendering Index
- 31. C.T. Current Transformer
- 32. C.T.B. Computer Terminal Board
- 33. CU. Copper

- 34. C.U. Compressor Condenser Unit
- 35. C.W. Cold Water
- 36. D.B. Direct Burial
- 37. D.C. Direct Current
- 38. Disc. Disconnect
- 39. DN. Down
- 40. DPST Double Pole Single Throw
- 41. E.C. Electrical Contractor (or General Contractor)
- 42. ELEV. Elevator
- 43. EMT Electric Metallic Tubing
- 44. Equip. Equipment
- 45. EST Estimate
- 46. FAAP Fire Alarm Annunciator Panel
- 47. FACP Fire Alarm Control Panel
- 48. FATC Fire Alarm Terminal Cabinet
- 49. FCCP Fire Alarm Command Center Panel
- 50. FHC Fire Hose Cabinet
- 51. FLA Full Load Amperes
- 52. FT. Feet
- 53. FTE Florida's Turnpike Enterprise
- 54. FLR Floor
- 55. F.C. Footcandles
- 56. FVNR Full Voltage Non-Reversing

- 57. GAL. Gallon
- 58. Galv. Galvanized
- 59. GPH Gallons per Hour
- 60. GPM Gallons per Minute
- 61. GFCI Ground Fault Circuit Interrupting
- 62. GRS Galvanized Rigid Steel Conduit
- 63. GND, GRD Ground
- 64. HTG Heating
- 65. HT Height
- 66. HZ Hertz (Cycles)
- 67. HPF High Power Factor
- 68. HPS High Pressure Sodium
- 69. HP. Horsepower
- 70. HR. Hour
- 71. H.S. Heat Strip
- 72. IMC Intermediate Metallic Conduit
- 73. Incand. Incandescent
- 74. in. Inches
- 75. J.B. Junction Box
- 76. kcmil Thousand Circular Mils
- 77. KVA KiloVolt Ampere
- 78. KW Kilowatts
- 79. KWH Kilowatt Hour

- 80. K Kelvin
- 81. L.L.D. Lamp Lumen Depreciation
- 82. LED Light Emitting Diode
- 83. LT. Light
- 84. LTG. Lighting
- 85. LTS. Lights
- 86. L.P.F. Low Power Factor
- 87. M.C.B. Main Circuit Breaker
- 88. M.D.P Main Distribution Panelboard
- 89. M.L.O. Main Lugs Only
- 90. Maint. Maintenance
- 91. MH. Manhole; Metal Halide
- 92. MFG. Manufacturer
- 93. max. Maximum
- 94. MCM Thousand Circular Mils
- 95. MPH Miles Per Hour
- 96. MM Millimeter
- 97. Min. Minute
- 98. MCP Motor Circuit Protector
- 99. MTD Mounted
- 100. N. Neutral
- 101. NEC National Electrical Code

- 102. NETA ATS International Electrical Testing Association, Acceptance Testing Specifications.
- 103. NEMA National Electrical Manufacturers Association
- 104. NFPA National Fire Protection Association
- 105. N.P.T. National Pipe Thread
- 106. NF Non Fused
- 107. N.C. Normally Closed
- 108. N.O. Normally Open
- 109. NIC. Not in Contract
- 110. No. Number
- 111. O.A.R. Owner's Authorized Representative (including A/E)
- 112. OD Outside Diameter
- 113. O.L. Overload
- 114. OLS Overloads
- 115. OS&Y Outside Screw and Yoke (Sprinkler)
- 116. % Percent
- 117. Ø Phase
- 118. P. Pole
- 119. P.T. Potential Transformer
- 120. PSF Pounds per Square Foot
- 121. PSI Pounds per Square Inch
- 122. PB Pullbox
- 123. PNL Panel
- 124. PR Pair

- 125. Pri. Primary
- 126. PVC Polyvinyl Chloride
- 127. Recept. Receptacle
- 128. RMC Rigid Metal Conduit
- 129. RPM Revolutions per Minute
- 130. SCA Short Circuit Amps
- 131. Sec. Secondary
- 132. S/N Solid Neutral
- 133. SPD Surge Protection Device
- 134. SPST Single Pole Single Throw
- 135. SF Square Foot
- 136. SW. Switch
- 137. SWBD Switchboard
- 138. Sys. System
- 139. THHN; THWN Nylon Jacketed Wire
- 140. TTB Telephone Terminal Board
- 141. TTC Telephone Terminal Cabinet
- 142. TV Television
- 143. TVTC Television Terminal Cabinet
- 144. TVEC Television Equip. Cabinet
- 145. TYP Typical
- 146. Temp. Temperature
- 147. U.L. Underwriters' Laboratories

- 148. VFD Variable Frequency Drive
- 149. VSD Variable Speed Drive
- 150. VHF Very High Frequency
- 151. VHO Very High Output
- 152. V Volt
- 153. VA Volt Amperes
- 154. Vol Volume
- 155. W Wire
- 156. W.P. Weatherproof
- 157. XFMR Transformer
- 158. Y Wye
- 159. Yd. Yard
- 160. Yr. Year
- 161. 3R Rainproof
- 162. 4X Stainless Steel Dusttight, Watertight

END OF SECTION 260504

SECTION 260505 - TEST AND PERFORMANCE VERIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION OF SYSTEM

- A. This section pertains to the furnishing of all labor, materials, equipment and services necessary to test and prove the performance of the electrical system.
- B. Operate the electrical system for a 3 day period. Set all the set points on the protective relays and circuit breaker trip units. Perform performance verification work as required to show that the system is operating correctly in accordance with the design. Supply instruments required to read & record the data. Adjust or modify the electrical system such that it operates at the required performance levels. Submit the completed test reports to the Engineer with the O&M Manuals.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTS

- A. System:
 - 1. General: After installation of all conductors, and before final acceptance, make required tests to determine proper functioning of all circuits. Furnish all necessary instruments required to make tests, and correct any deficiencies found. Prior to energizing, circuits shall be “ringed-out” and “meggered” to verify opens, shorts, and non-intentional grounds.
 - 2. Procedure:
 - a. Insulation resistance of all feeder conductors and all conductors AWG #1 and larger shall be tested. This is to include all new conductors and/or all existing conductors that are connected and/or extended. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps, and connections are made except connection to source and point of final termination at distribution or utilization equipment.
 - b. Insulation resistance of conductors shall be tested by using a calibrated AVO biddle (or approved equal) Megger. The applied potential shall be 1000 VDC for 600 Volt rated conductors. Resistance shall be measured from “phase to phase” and “phase to ground” and corrected for temperature. Testing methodology shall

conform to NETA Acceptance Testing Specifications – year 1999, section 7.3 Acceptable insulation resistance is (1) Mega ohm or greater.

- c. Conductors that do not satisfy test requirements (b.) above shall be removed, replaced, and testing repeated on new cable, at no additional costs to the General Contractor or Department. All tests shall be performed by licensed electrician trained in the use of the test instrument. Furnish all instruments and personnel required for tests, shall tabulate readings observed and complete “Conductor Insulation Resistance Test” form (found at the end of section 2600507) and submit five (5) copies to Engineer for approval. Test shall be witnessed by the Department’s representative and Engineer (if so desired). Final approval data is to be submitted in O & M Manual.
 - d. Test reports shall identify each feeder conductor tested, date, time, and result of test, weather conditions, and range, test voltage, and serial number of the megger instrument used. Any conductor or splice that is found defective shall be promptly removed and replaced, and additional test shall be performed.
 - e. Observe all safety instruction set by testing equipment manufacturer. Application of voltage testing involves risk of electric shock and sparking.
3. Take readings of voltage and amperage at building main disconnect switch and at main for each panel, at primary and secondary side of each transformer and at the end of the longest branch circuit at each panel. The above readings shall be taken (1) “no load” conditions and (2) “full load” conditions with all equipment using electricity. Tabulate readings, complete “TABULATED DATA VOLTAGE AND AMPERAGE READINGS” form (found at the end of Section 2600507) and submit five (5) copies to the engineer for approval. Final approved data is to be submitted in O & M manual.

B. Motors:

- 1. Tests run each motor via motor’s control unit in both manual mode and automatic mode. Verify proper operation and voltage.
- 2. Test run each motor furnished under this division of the specifications and all existing motors specifically noted on the drawings and/or specifications to be tested:

- a. With the system energized, line-to-line voltage and line current measurements shall be made at the motors under full load conditions. Should measured values deviate $\pm 10\%$ from the nameplate ratings, the condition shall be corrected. Notify the engineer immediately should deviations occur.
- b. Record results of existing motors tested and submit values to A/E in writing.
- c. Test the insulation resistance's of all motor windings to ground with a "megger" before applying line voltage to the motors. If these values are less than one meg ohm the contractor furnishing the motor shall be responsible for correcting the error.
- d. Determine power factor of motor(s) at full load.
- e. Tabulate readings, complete "Motor Test Information" form (found at the end of Section 260507) and submit five (5) copies to the engineer for approval. Final approved data is to be submitted in O & M manual.

C. Grounds:

1. Test each raceway for raceway continuity as called for in Section 260526, "GROUNDING AND BONDING".
2. Test each grounding system used in the project as called for in Section 260526 "GROUNDING AND BONDING".
3. Submit "GROUND TEST INFORMATION" form (see form at the end of section 260507) for each and every grounding system in the project including but not limited to: each ground rod installation; each water pipe and ground installation (test water pipe to ground and test water pipe to building service equipment); and each building steel ground connection (test building steel to ground and test building steel to building service equipment).
4. Grounding resistance shall be as called for in Section 260526, "GROUNDING AND BONDING".
5. Testing shall be three (3) point fall of potential method in accordance with IEEE recommended practice.

D. Communications, etc.:

1. See specific sections of these specifications for further requirements.

3.2 DATA PROCESSING

A. Testing Data:

1. Tabulate data for submission.
2. Submit data on 8 1/2" x 11" sheets with date and name of the testing Technician. Include one copy of the testing data in each Operation and Maintenance manual.
3. Where specific performance verification information is called for in the specifications, use copies of the sheets provided for recording readings.
4. Data shall be submitted and approved before check-out memos are signed or a request for final inspection is made.

B. Equipment Check-Out:

1. At completion of construction after all performance verification and testing information has been gathered, submitted, and approved, provide one copy of this information to the authorized manufacturer's representative of the equipment.
 - a. Manufacturer's authorized representative must be trained by the manufacturer and authorized to inspect, adjust, test, and repair equipment.
2. Work required under this section shall include having the representative examine the performance verification information, check the equipment in the field while it is operating, and sign a check-out memo for a record.
 - a. Check out of equipment is to include examining performance of equipment and certifying equipment has been installed per manufacturer's recommendations that all necessary adjustments have been performed and that equipment is operating properly.
3. Submit one (1) copy (for each operation and maintenance manual) of the memo on each major item of equipment. Approved memos shall be inserted in each O & M manual with the performance verification information and submittal data. Memos shall be submitted and approved before instruction to the Department or a request for final inspection.
4. Items requiring check-out memos are all major items of equipment such as (but not limited to):

- a. Panels, distribution panels, switchboards
 - b. Transformers
 - c. UPS equipment
 - d. Generators
 - e. Lighting control systems
 - f. Feeders
 - g. Motors
 - h. Equipment/system installed per Sections 270000 through 280000.
 - i. Any other equipment noted to be checked-out by engineer during construction.
5. Do not submit Check-out Memo form at the time Submittal Brochures are submitted. This form shall be completed and submitted in the O&M Manuals.

END OF SECTION 260505

SECTION 260506 - DEMONSTRATION OF COMPLETED ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DEMONSTRATION

- A. Demonstrate to the Department the essential features of the following electrical systems (if applicable):
 - 1. Communications Systems
 - a. Each and every system included in Sections 270000 and 280000
 - 2. Electrical Entrance Equipment
 - a. Circuit breakers
 - b. Fuses and fuseholders
 - c. Meters (where applicable)
 - 3. Miscellaneous Electrical Equipment
 - a. Kitchen exhaust hood shut down
 - b. Electrical systems controls and equipment
 - c. Electrical power equipment
 - d. Motor control centers
 - e. Motor control devices
 - f. Relays
 - g. Special transformers
 - h. Starting devices
 - i. Surge suppression equipment
 - 4. Lighting Fixtures (include relamping and replacing lenses)
 - a. Exit and safety fixtures
 - b. Fixtures, indoor and outdoor
 - c. Lighting control system
 - 5. Lightning Protection System
 - 6. Distribution Equipment
 - a. Lighting & Appliance Panelboards
 - b. Distribution panels
 - c. Switchboard
 - d. Voltage stabilizers

- 7. Standby Electrical Equipment
 - a. Batteries
 - b. Battery chargers
 - c. Controls and alarms
 - d. Emergency generators, transfer switches
 - e. UPS systems
- 8. Wiring Devices
 - a. Low-voltage controls
 - b. Switches: regular, time

B. Each system shall be demonstrated once only, after completion of testing.

1.2 TIME

A. The demonstration shall be held upon completion of all systems at a date to be agreed upon in writing by the Department or representative.

1.3 ATTENDING PARTIES

A. The demonstration will be in the presence of the Department, and the manufacturer's representative.

1.4 DEMONSTRATION

- A. Demonstrate the function and location (in the structure) of each system, and indicate its relationship to the riser diagrams and drawings.
- B. Demonstrate by "start-stop operation" how to work the controls, how to reset protective devices, how to replace fuses, and what to do in case of emergency.
- C. Certificate of Completed Demonstration.
 - 1. Submit one (1) copy (for each O & M manual) of Certificate of Completed Demonstration Memo Form (found at the end of Section 260507) signed by the contractor, subcontractor and Department for each type of equipment and system. Insert one copy in each O & M manual.

END OF SECTION 260506

SECTION 260507 - OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for Operation and Maintenance Manuals (O & M Manuals) specifically applicable to Division 26 Sections.

1.2 OPERATION AND MAINTENANCE MANUALS

- A. O & M Manuals shall consist of black, hard cover binders, with three (3) D shaped rings, PVC free cover material, no print transfer - non stick material, 100% Recycled material, and sized to hold 8 1/2" x 11" sheets.
Provide one (1) manual for Power Distribution (sections 260505, 260533 – 263600, and 264313).
Provide one (1) manual for Lighting, (sections 265113 – 265629).
Provide one (1) manual for Systems (Sections 262924 - 260923).
 - 1. Each binder is to be adequately sized to comfortably hold the required contents of the manual. Minimum spline size to be 1", maximum spline size to be 3" (provide additional binders if 3" size is not sufficient to hold the contents of the manual).
 - 2. Binder covers to have outer clear vinyl pocket on front cover (to hold 8 1/2 x 11" sheet) and on spline (to hold spline width x 11" sheet). Provide correct designation of project in each pocket, see "examples" included at the end of this section. Description sheet is to be white with black letters, minimum of 11" high and full width of pocket. Description is to describe project and match project drawing/spec description. Description to include the manual type, i.e. "Electrical" for power and lighting O & M Manuals or "Systems" for Section 270000 and 280000 O & M Manuals.
 - 3. Binders shall be labeled to describe type, i.e. "Electrical" for power and lighting of the O & M Manuals or "Systems" for Sections 270000 and 280000 of the O & M Manuals.
- B. O & M Data:
 - 1. Manufacturer's operation and maintenance data is required for all items as called for in the specifications. O & M's shall include manufacturer's name, model number(s), characteristics, manufacturer's agent, service agent, supplier, and where the item was installed. (i.e. surge suppression - switchboard MDP).

2. Include troubleshooting instructions, list of special tools required, theory of operation, manufacturer's care and cleaning, preventative maintenance instructions, wiring diagrams, and point-to-point schematics.

C. O & M Manuals to include:

1. Include a table of contents, project address, and project information.
2. Provide reinforced separation sheets tabbed with the appropriate specification reference number and typed index for each section in the Systems Schedule.
3. Shop Drawings: Shop drawings shall be a copy of the final and approved shop drawing submitted as required in Section 260501 "Submittals". These shall be inserted in binder in proper order.
4. Product Data: Product data and/or Catalog sheets shall be a copy of the final and approved submittal submitted as required in Section 260501 "Submittals". These shall be inserted in binder in proper order.
5. Warranty/Guarantee: Provide copy of warranty/guarantee in respective location in O & M manual binder (power/lighting and systems). Original warranty/guarantee is to be incorporated into separate project warranty book with warranty/guarantees provided for other sections and divisions of the specifications and submitted for Architectural/Owner approval.
6. Copies of electrical panel schedules and electrical panel directories included with the corresponding specification section.
7. Wiring diagrams, schematic, etc. inserted in proper order, for:
 - a. Engine Generator, Battery charger, ATS, Fuel monitoring system, Remote annunciator, site specific interconnect diagram.
 - b. Control devices, motor controls
 - c. Transformers
 - d. Panelboards and Switchboards
 - e. Each and every part of the systems sections of these specifications, 270000 and 280000
8. For Sections 260519 through 260553 and 262716 through 262726:
 - a. Product data and/or catalog sheets on all equipment applicable to this project.

- b. Equipment supplier list for each section's equipment.
 - c. Floor boxes; in addition to above, provide:
 - (1) Installation/removal instructions
 - (2) Parts list
 - d. Ground fault wiring devices; in addition to above, provide:
 - (1) Wiring diagram
 - e. Grounding; in addition to above, provide:
 - (1) Test results on each ground rod
 - (2) Submit Ground Test Form
9. Sections 262213 through 262914 and 263600:
- a. Product data and/or catalog sheets on equipment applicable to this project.
 - b. Equipment supplier list for each section's equipment.
 - c. Transformers; in addition to above provide:
 - (1) Recommended periodic testing procedures.
 - (2) Parts list
 - (3) Any special manufacture suggested O & M information
 - (4) Installation/removal instructions
 - d. Panels, distribution panelboards, switchboards; in addition to above provide:
 - (1) Internal wiring diagrams
 - (2) Bus diagrams
 - (3) Operation and maintenance requirements, instructions, and recommended testing
 - (4) Parts list
 - (5) Copy of directory
 - (6) Voltage and amperage readings
 - e. Overcurrent protective devices; in addition to above provide the following for large circuit breakers:
 - (1) Parts list
 - (2) Operation and maintenance requirements

- (3) Wiring diagrams
- (4) Testing data
- (5) Installation/removal instructions
- (6) Check-out memo

10. Section 265000:

- a. Product data and/or catalog sheets on all equipment applicable to this project.
- b. Equipment supplier list for each sections equipment.
- c. Lighting fixtures; in addition to above, provide the following:
 - (1) Operation and maintenance requirements/instructions for special light fixtures (these fixtures to be determined by A/E) including:
 - (a) Installation/removal instructions
 - (b) Special relamping instructions
 - (2) Parts list

11. Section 264113 through 264313 and 263213:

- a. Engine Generator, Battery charger, ATS, Fuel monitoring system, Remote annunciator, site specific interconnect diagram.
- b. O&M Manuals and Parts Manuals for the engine generator and the Automatic Transfer Switches.
- c. Product data and/or catalog sheets on all equipment applicable to this project.
- d. Equipment supplier list for each section's equipment.

12. Sections 270000 and 280000:

- a. Installer's name, address, phone, etc. for each system.
- b. Authorized representative's name, address, phone, etc. for each system.
- c. Equipment supplier's name, address, phone, etc. for each system.
- d. Surge Suppression

- (1) Product data and/or catalog sheets on equipment applicable to this project
 - (2) Parts list
 - (3) Recommended testing and replacement procedures
- e. Fire Alarm
 - (1) Product data and/or catalog sheets on equipment applicable to this project.
 - (2) Parts list
 - (3) Installation/removal instructions
 - (4) Wiring diagrams of panels\
 - (5) Point-to-Point wiring diagrams of system
 - (6) Operation and maintenance requirements
 - (7) Shop drawing as submitted and approved in submittal process
 - (8) Check-out memos
- f. Telephone, Computer Systems:
 - (1) Product data and/or catalog sheets on equipment applicable to this project
 - (2) Parts list
 - (3) Wiring diagrams of panels
 - (4) Shop drawing as submitted and approved in submittal process
- 13. Any specifically requested equipment check-out memos. (see form at the end of this section).
- 14. Project Addresses (see form at the end of this section).
- 15. Required Check-out memo (see form at the end of this section).
- 16. Progress and Record Drawing Certification (see form at end of this section).
- 17. Tabulated Data-Voltage and Amperage Readings (see form at end of this section).
- 18. Conductor insulation resistance test memo (see form at end of this section).
- 19. Motor Test Information (see form at end of this section).

20. Ground Test Information (see form at end of this section).
21. Spare Parts Certification Memo (see form at end of this section).
22. Certificate of Completed Demonstration Memo (see form at end of this section).

1.3 PROCESSING THE O & M SUBMITTALS

- A. Review the manuals before submitting to the A/E. No request for payment will be considered until the brochure has been reviewed and submitted for approval.

1.4 DELAYS

- A. Take responsibility for delays in job project accruing directly or indirectly from late submissions or resubmissions of shop drawings, or product data.

1.5 RESUBMITTALS

- A. The A/E shall be reimbursed for the cost to review re-submittals subsequent to the second submittal.

“EXAMPLE”

ELECTRICAL SYSTEM O & M MANUALS

FLORIDA’S TURNPIKE ENTERPRISE

XYZ TOLL PLAZA

FPID #515462-2-62-01

ORLANDO, FLORIDA

ARCHITECT:

ENGINEER:

GENERAL CONTRACTOR:

SUBCONTRACTOR:
(Provide list of all subcontractors)

VOLTAGE AND AMPERAGE READINGS AT COMMISSIONING

PROJECT NAME: _____

SWITCHBOARD/PANELBOARD LABEL: _____

AMPERAGE READINGS

PHASE A. _____

B. _____

C. _____

N. _____

DATE _____

TIME _____

VOLTAGE READINGS

PHASE A to N _____ A to B _____

B to N _____ A to C _____

C to N _____ B to C _____

DATE _____

TIME _____

ENGINEER'S REPRESENTATIVE

DEPARTMENT'S AUTHORIZED
REPRESENTATIVE

CONTRACTORS REPRESENTATIVE

CONDUCTOR INSULATION RESISTANCE

PROJECT NAME:

CONDUCTOR FROM _____ TO _____

SIZE: _____

LENGTH

INSULATION TYPE: _____

INSULATION VOLTAGE RATING:

DATE _____ TIME _____
CONDITIONS _____

WEATHER

TEST VOLTAGE (DC) _____

AMBIENT TEMPERATURE

MEGGER INSTRUMENT/SERIAL NUMBER _____

RESISTANCE MEASUREMENTS:

A to B _____ Meg Ω

A to GND _____ Meg Ω

B to C _____ Meg Ω

B to GND _____ Meg Ω

C to A _____ Meg Ω

C to GND _____ Meg Ω

N to GND _____ Meg Ω

Note any insulation damage or improper installation _____

Verify proper color code for each phase, neutral and ground. See specifications 16123.

TEST CONDUCTED BY _____

FALL OF POTENTIAL GROUND RESISTANCE TEST

PROJECT NAME:

SOIL TYPE _____ WEATHER CONDITIONS _____

GROUNDING ELECTRODE TYPE _____

GROUNDING ELECTRODE LOCATION _____

DISTANCE BETWEEN INTERCONNECTED GROUNDS RODS _____

C2 – DISTANCE TO THE CURRENT PROBE _____

P2 – DISTANCE TO THE POTENTIAL PROBE _____

R – RESISTANCE _____ Ω

R
E
S
I
S
T
A
N
C
E

FEET

TEST CONDUCTED BY _____ DATE _____

SPARE PARTS CERTIFICATION

This form shall be completed and provided to the Owner at the Owner's Performance Verification and Demonstration meeting. A copy shall also be included in the O &M Manual for the equipment as specified.

PROJECT NAME:

SPECIFICATION REFERENCE SECTION _____

LIST OF SPARE PARTS QUANTITY	MFR PART #
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____

Signature below by the contractor signifies that the spare parts required by the contract documents have been turned over to the Department.

GENERAL CONTRACTOR _____ DATE _____

END OF SECTION 260507

SECTION 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable
- B. Wiring connectors and connections

1.2 RELATED SECTIONS

- A. Section 260533 – Raceway and Boxes for Electrical Systems

1.3 REFERENCES

- A. NECA Standard of Installation (National Electrical Contractors Association)
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association)
- C. NFPA 70 - National Electrical Code

1.4 SUBMITTALS FOR REVIEW

- A. Section 260500 - Submittals: Procedures for submittals.
- B. Product Data: Provide data for each type of conductor, connector and termination.

1.5 SUBMITTALS AT PROJECT CLOSE-OUT

- A. Project Closeout, Warranties
- B. Project Record Documents: Record actual locations of components and circuits.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years experience.

1.7 PROJECT CONDITIONS

- A. Coordination and Meetings
- B. Conductor sizes on the drawings are based on copper.
- C. Aluminum wiring is not permitted.
- D. Ensure all sizes are given in American Wire Gauge (AWG) or in thousand circular mils (kcmil).

1.8 COORDINATION

- A. Coordinate Work with other trades.
- B. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
- C. Determine required separation between cable and other work.
- D. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. THHN/THWN Single Conductors: 600 Volt, PVC insulation, with a nylon thermoplastic outer jacket. Ensure the solid or stranded conductors are made of annealed copper and rated for 90°C in dry locations, and 75°C for wet or below grade locations. Suitable for use in residential, commercial and industrial environments.
- B. XHHW Single Conductors: 600 Volt, XLP insulation. High heat and moisture resistant. Ensure the solid or stranded conductors are made of annealed copper and rated for 90°C in dry locations, and 75°C for wet or below grade locations. Suitable for use in residential, commercial and industrial environments.

2.2 WIRING CONNECTORS

- A. Insulated Mechanical Connectors for 8 AWG and larger, in dry locations
- B. Spring Wire Connectors/Wire Nuts for 10 AWG and smaller, in dry locations
- C. Compression Connectors: Raychem with heat shrink insulating covers, in dry locations.

- D. Roll on & wrap around UF splice kits with EDPM elastomer sealant and UV resistant insulating sleeve, in wet locations or below grade.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Coordination and Meetings: Verification of existing conditions before starting work.
- B. Verify that interior of building has been protected from weather.
- C. Verify that mechanical work likely to damage wire and cable has been completed.
- D. Verify that raceway installation is complete and supported.
- E. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final approved submittal for equipment to assure proper number and size of the conductors. (As for multiple speed motors, different motor starter arrangements, etc.).

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Route wire and cable as required to meet the Project Conditions.
- C. Install cable in accordance with the NECA "Standard of Installation".
- D. Use solid conductor wire for feeders and branch circuits 10 AWG and smaller and use stranded conductors for #8 AWG and larger.
- E. Use conductor not smaller than 12 AWG for power and lighting circuits.
- F. Increase branch conductor sizes as required to maintain a branch circuit voltage drop of less than 3% to the load served
- G. Ensure all 120V, 20A circuit homeruns over 50ft. are #10 cu. minimum unless noted otherwise.
- H. Ensure all 120V, 20A circuit homeruns over 150ft. are #8 cu. minimum, unless noted otherwise.

- I. Pull all conductors into the raceway at same time. Do not exceed the manufacturer's recommended pulling tensions.
 - 1. Do not pull wire until the conduit system is complete from pull point to pull point and major equipment terminating conduits have been fixed in position.
 - 2. Ensure bending radius of insulated wire or cable is not be less than the minimum recommended by the manufacturer.
 - 3. Where coaxial or fiber optic conductors are installed, special requirements apply as outlined under that specific system detail specifications.
- J. Use suitable wire pulling lubricant for building wire. Ensure compound or lubricant does not cause the conductor or insulation to deteriorate.
- K. Neatly train and lace wiring inside boxes, equipment, and Panelboards.
- L. Identify wire and cable under provisions of Section 260553. Identify each conductor with its circuit number or other designation indicated.
- M. Install all power and lighting conductors in a NEC approved raceway.
- N. Ensure conductor sizes indicated on circuit homeruns or in schedules are installed over the entire length of the circuit.
- O. Install all conductors in raceway.
- P. Ensure conductor sizes indicated on circuit homeruns or in schedules are installed over the entire length of the circuit unless noted otherwise on the drawings or in these specifications.
- Q. Place an equal number of conductors for each phase of a circuit in same raceway. Up to three current carrying conductors may be installed in a raceway. Do not combine homeruns.

3.4 VERTICAL RISERS

- A. Provide vertical cable riser supports per NFPA 70. Cable supports shall be O-Z/Gedney Type "S" or equal. These shall be located in accessible pull boxes of adequate size. Provide for adequate structural connections of the cable supports to the pullbox, which will transfer the weight of the cables to the building.

3.5 CONTROL AND SIGNAL CIRCUITS

- A. For control and signal circuits above 50 VAC, conductors shall be #14 AWG minimum size, THWN/THHN.

- B. For control and signal circuits 50 VAC and below, conductors, at the Contractor's option, may be #16 AWG, 300 volt rated, PVC insulated, except where specifically noted otherwise in the contract documents.
- C. Conductor insulation for Fire Alarm Systems shall be as approved by Code Inspection Authority only. Wire approvals by the A/E shall not supersede this final Approval for conditions of this specific project.
- D. All control and signal circuit conductors shall be stranded copper conductors.

3.6 COLOR CODING

- A. All feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for the system throughout the building. Feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape or paint in all junction boxes and panels. Tape or paint shall completely cover the full length of conductor insulation within the box or panel.
- B. Unless otherwise approved, or to match the existing, the color-codes shall be as follows:

UTILITY or GENERATOR POWER

480/277 Volt, 3 phase, 4 wire

Phase A = brown

Phase B = orange

Phase C = yellow

Neutral = gray

Equip ground = green

208/120 Volt, 3 Phase, 4 Wire

Phase A = black

Phase B = red

Phase C = blue

Neutral = white

Equip ground = green

120/240 Volt, 1 Phase, 3 Wire

Line 1 = black

Line 2 = red

Neutral = white

Equip Ground = green

UPS POWER / CLEAN POWER

208/120 Volt, 3 Phase, 4 Wire

Phase A = black

Phase B = red

Phase C = blue

Neutral = white with yellow stripe down the entire length

Equip ground = green with yellow stripe

120/240 Volt, 1 Phase, 3 Wire

Line 1 = black

Line 2 = red

Neutral = white with yellow stripe

Equip ground = Green with yellow stripe

3.7 TAPS/SPLICES/CONNECTORS/TERMINATIONS

- A. Clean conductor surfaces before installing lugs and connectors.
- B. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- C. Conductors shall be continuous and unspliced where located within conduit. Splices shall occur within troughs, wire ways, junction boxes, outlet boxes, or equipment enclosures where sufficient additional room is provided for all splices. No splices shall be made in in-ground pull boxes (without written approval of engineer).
- D. Allow adequate conductor lengths in all junction boxes, pull boxes and terminal cabinets. All termination of conductors in which conductor is in tension will be rejected and shall be replaced with conductors of adequate length. This requirement shall include the providing by the Contractor of sleeve type vertical cable supports in vertical raceway installations provided in pull boxes at proper vertical spacing.
- E. A calibrated torque wrench shall be used for all bolt tightening.
- F. Interior Locations:
 - 1. All (non-electronic systems) copper taps and splices in No. 10 or smaller shall be fastened together by means of "spring type" connectors. All taps and splices in wire larger than No. 10 shall be made with compression

type connectors or split bolt connectors and taped to provide insulation equal to wire.

G. Exterior Locations:

1. All taps and splices shall be made with compression type connectors and covered with Raychem heavy wall cable sleeves (type CRSM-CT, WCSM or MCK) with type "S" sealant coating with sleeve kits as per manufacturer's installation instructions or be terminated/connected to terminal strips in above grade terminal boxes suitable for use.

H. Clean conductor surfaces before installing lugs and connectors.

- I. Make splices, taps, and termination's to carry full ampacity of conductors with no perceptible temperature rise.

3.8 FIELD QUALITY CONTROL

A. Quality Control

- B. Perform inspections and tests listed in 1999 NETA ATS, Section 7.3

END OF SECTION 260519

SECTION 260520 - EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment specified under other sections.

1.2 RELATED SECTIONS

- A. Electric Elevators – Passenger
- B. Electric Motors
- C. Plumbing Equipment
- D. Air Cooled Condensing Units
- E. Computer Room Air Conditioning Units
- F. Air Handling Units
- G. Built-Up Air Handling Unit
- H. Power Ventilators
- I. Controls and Sequence of Operation
- J. Conduit
- K. Section 260519 – Low Voltage Electrical Power Conductors and Cables
- L. Section 260533 – Raceway and Boxes for Electrical Systems

1.3 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices
- B. NEMA WD 6 - Wiring Device Configurations
- C. ANSI/NFPA 70 - National Electrical Code

1.4 SUBMITTALS

- A. Submit under provisions of Section 260500.

- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 COORDINATION

- A. Coordinate work under provisions of Sections 260500.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- E. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible metal conduit. Use liquid tight flexible metal conduit with watertight connectors in damp or wet locations.
- C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

- F. Install disconnect switches, controllers, control stations, and control devices as indicated.
- G. Modify equipment control wiring with terminal block jumpers as indicated.
- H. Provide interconnecting conduit and wiring between devices and equipment where indicated.
- I. Recorder Rooms and Computer Rooms: Seal the conduit openings where the conduit passes from a cold environment to a hot environment.

END OF SECTION 260520

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding electrodes and conductors
- B. Equipment grounding conductors
- C. Bonding

1.2 RELATED SECTIONS

- A. Section 26413 - Lightning Protection for Structures

1.3 REFERENCES

- A. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association)

1.4 GROUNDING SYSTEM DESCRIPTION

- A. Metal underground water pipe
- B. Metal frame of the building
- C. Concrete-encased electrode
- D. Rod electrode

1.5 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms from Ground rod to earth by Fall of Potential test.

1.6 SUBMITTALS FOR REVIEW

- A. Section 260500 - Submittals: Procedures for submittals.
- B. Product Data: Provide data sheets for all grounding electrodes, clamps, bonding straps, ground bars, and inspection wells.
- C. Site specific One-Line Grounding Plan that indicates all grounding electrode conductor connection points and sizes at the service disconnect, automatic

transfer switch (ATS), back-up generator, and the uninterruptable power supply (UPS). Specify locations for grounding system inspection wells.

1.7 SUBMITTALS FOR INFORMATION

- A. Section 260500 - Submittals: Submittals for information.
- B. Test Reports: Indicate overall resistance to ground and resistance of each rod electrode.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.8 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout
- B. Project Record Documents: Record actual locations of components and grounding electrodes.
- C. Certificate of Compliance: Indicate approval of the grounding installation by the authority having jurisdiction.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

- A. Material: Copper-clad steel
- B. Diameter: 5/8 inch
- C. Length: 20 feet total length.

2.2 MECHANICAL CONNECTORS

- A. Material: Bronze

2.3 EXOTHERMIC CONNECTIONS

- A. Manufacturers:

1. Cadweld

2.4 WIRE

- A. Material: Stranded or solid copper
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

2.5 GROUNDING WELL COMPONENTS

- A. Light weight polymer concrete inspection wells will meet ASTM C-857 specifications. HARGER Cat# GAW121212HD, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions prior to beginning the work.
- B. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

- A. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve 10 Ohms resistance to ground, measured by Fall of Potential method. Service entrance ground rod electrodes shall consist of two 20 ft driven rods spaced 20 feet apart.
- B. Provide a grounding inspection well with hinged cover at each driven rod location in the power distribution system (not for lightning protection system). Install well top flush with finished grade.
- C. Provide grounding electrode conductors and connect to the reinforcing steel in foundation footing, the structural steel if available, the main cold water pipe if it is metal, and the driven ground rods.
- D. A main bonding jumper shall connect the neutral bus to the ground bus at the first service disconnect.
- E. The main grounding electrode conductor shall be continuous and shall not be spliced or broken at the wall mounted ground bus.
- F. Provide bonding to meet NFPA 70 and Regulatory Requirements (i.e., metal duct work, metal piping, gas piping etc.).

- G. Bond together metal siding not attached to grounded structure; bond to ground.
- H. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Ground the metal wall studs when conductors are installed through holes in the studs.
- I. Interface with lightning protection system installed under Section 16620.
- J. Provide ground bar bus at all terminal boards and bond to main electrical room ground bus (#4 CU minimum unless indicated larger on the plans).
- K. Provide wall mounted auxiliary equipment ground bus (1/4" x 2" x 12" minimum) in the main electrical room and bond to the main switchboard equipment grounding bar with # 3/0 CU.
- L. Provide wall mounted ground bus bar (1/4" x 2" x 8" minimum) in each distribution electrical room or closet. Bond to load side of step down transformer. If electrical room does not contain a transformer bond to largest panel bond ground bus with #3 CU minimum unless indicated larger on the plans.
- M. Provide hydraulically crimped connections for all connections made below grade.
- N. Bond all metal pull/junction box covers used with concrete, plastic, fiberglass, composite or other non-metal pull boxes to the equipment grounding conductor with #8 CU minimum unless noted otherwise.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in 1999 NETA ATS, Section 7.13.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports
- B. Anchors and fasteners

1.2 REFERENCES

- A. NECA - National Electrical Contractors Association
- B. ANSI/NFPA 70 - National Electrical Code

1.3 SUBMITTALS

- A. Submit under provisions of Section 260500.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. and acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:

1. Concrete surfaces and structural elements: Use expansion anchors, preset inserts, and self drilling anchors.
2. Steel Structural Elements: Use beam clamps.
3. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
4. Solid Masonry Walls: Use expansion anchors, preset inserts, and self drilling anchors.
5. Sheet Metal: Use galvanized sheet metal screws.
6. Wood Elements: Use wood screws.

2.2 STEEL CHANNEL

- A. Manufacturer: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered).
 1. Kindorf
 2. Unistrut
 3. Beeline
- B. Description: Galvanized for exterior applications and Painted steel for indoor applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not use spring steel clips and clamps and metal banding straps.
- E. Do not use powder-actuated anchors.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

- I. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- J. Concrete/insert anchors, thread rods, or similar fasteners installed on side or bottom of pre-stressed beams are not acceptable.
- K. In wet and damp locations use stainless steel channel supports to stand cabinets and panelboards 3/4 inch (25 mm) off wall.
- L. All items shall be supported directly from structural portion of the building. All above ceiling or ceiling mounted items shall be supported directly from building superstructure, except standard lay-in type ceiling lighting fixtures, and small outlet boxes for devices such as exit lights. Lay-in type ceiling fixtures shall be provided with supplemental support wire or chain as specified elsewhere. Outlet boxes shall be attached to ceiling system by means of approved mounting brackets and shall also be provided with supplemental threaded rod hangers from super structure as specified elsewhere. No sagging of the ceiling will be permitted. Adjust supplemental supports accordingly.
- M. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels. Support conduit and boxes independent of the ceiling per NEC-article 300.11 (latest addition). Lighting fixtures and devices shall have supplemental supporting as specified herein.
- N. All conduits shall be securely fastened in place and hangers, supports or fastenings shall be provided at each elbow and at the end of each straight run terminating at a box or cabinet. The use of perforated iron for supporting conduits will not be permitted. The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables.
- O. Parallel groups of conduit or conduit runs in a similar direction; they shall be grouped together and supported by means of 1½" x 1½", 12 gauge, pre-galvanized zinc (B-Line or approved substitution), conduit channel trapeze hanger system (racking) consisting of concrete inserts, threaded rods, washers, nuts, locknut washers, etc. Where galvanized "L" angle iron is used, conduits shall be individually fastened to the cross members with malleable iron hangars listed and approved for use on "L" angle iron, bolted with proper size cadmium machine bolts, washers and nuts. Conduits supported to unistrut channel shall be individually fastened with two piece unistrut straps with bolts and nuts listed and approved for such use. Mineralak hangars or one hole type straps fastened to Kindorf racking is not acceptable. Beam clamps shall be malleable iron.
- P. Hangers for PVC coated conduit shall be PVC coated galvanized conduit.

- Q. On concrete or brick construction, insert anchors shall be installed with round head machine screws. In wood construction, round head screws shall be used. An electric or hand drill shall be used for drilling holes for all inserts in brick, concrete or similar construction. In brick, inserts shall be near center of brick, not near edge or in joint. Where steel members occur, same shall be drilled and tapped, and round head machine screws shall be used. All screws, bolts, washers, etc., used for supporting conduit or outlets shall be fabricated from rust-resisting metal, or approved substitution. Fasteners similar to "TAP-CON" self tapping power driven type are acceptable on interior block walls only. Plastic anchors and explosive fasteners are not acceptable.
- R. Threaded rod hangars shall be galvanized continuous thread type, minimum 3/8" diameter. Increase size as required to support assembly. Bending of rod hangars is not permitted.
- S. Support channel (unistrut) shall be 1-1/2" x 1-1/2", 12 gauge, pre-galvanized zinc (B-Line or approved substitution). 3/4" x 3/4" unistrut channel is acceptable on wall-mounted applications to support raceways at panelboards or where special written permission is granted by A/E.
- T. Conduit support racks shall be minimum of 24", increase, distance as required for quantity of conduits and spare capacity) provide space on each rack for 25 percent additional conduits. Group conduits on channel racking adjacent to each other at sides, allowing all remaining unused space at center as spare capacity. Spacing between conduits shall not exceed 1" unless written permission is granted by architect/engineer.
- U. Each rack shall be provided with minimum of two (2) all-thread rod hangars located at the ends of the channel. Increase number of hangars as required to support assembly.
- V. In general conduit supporting devices such as spring type conduit clips manufactured by Caddy Corporation are not acceptable. Caddy type conduit clips with snap close strap is acceptable for use in dry interior concealed locations, where steel peril type construction is used. Back to back arrangement or attachment to other raceways, piping, etc. is not permitted.
- W. All hangers, clips and accessories for supporting shall be UL listed.
- X. Support systems shall meet requirements for seismic loads. Refer to general Conditions of the specifications.
- Y. All hangers and mounting hardware clamps shall be made of durable material suitable for the application involved. Excessive corrosive conditions, exterior and wet locations (i.e. kitchens, wash-down, etc.) conditions are encountered, hanger assemblies, supporting hardware and materials shall be made of malleable iron, hot dipped galvanizing steel, or stainless steel.

- Z. Attachment of cables to ceiling system or support wires, regardless if support wire is a dedicated wire, is prohibited. Support cables directly to building superstructure. Only a vertical cable drop down to a recessed lay-in luminaire can be supported to the fixture support wire with approved fasteners. Vertical cable drop attachment may be by means of Ty-Rap cable tie if approved by the Local Inspecting Authority having jurisdiction and UL plenum rated within plenum air environments.
- AA. Materials installed in environmental air plenum s shall be UL Plenum Listed and bear the appropriate UL markings.
- BB. Free-air cable, where specified and permitted elsewhere, shall be supported directly from the superstructure with UL Listed devices intended for such use. Ty-Rap cable ties in conjunction with UL Listed support devices shall be UL plenum rated within plenum air environments.
- CC. Comply with requirements of Specification section 260533

END OF SECTION 260529

SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rigid metal conduit (RMC)
- B. PVC coated or Bituminous coated rigid metal conduit
- C. Flexible metal conduit (FMC)
- D. Liquid-tight flexible metal conduit
- E. Electrical metallic tubing (EMT)
- F. High Density Polyethylene (HDPE)
- G. Rigid nonmetallic conduit (PVC)
- H. Liquid-tight flexible nonmetallic conduit
- I. Fittings and conduit bodies
- J. Wall and Ceiling Outlet Boxes
- K. Floor Boxes
- L. Pull and Junction Boxes

1.2 RELATED SECTIONS

- A. Fire Stopping
- B. Roofing Penetrations
- C. Section 260500 – Common Work Results for Electrical
- D. Section 260519 – Low Voltage Electrical Power Conductors and Cables
- E. Section 260526 - Grounding and Bonding for Electrical Systems
- F. Section 260529 – Hangers and Supports for Electrical Systems
- G. Section 260553 – Identification for Electrical Systems

- H. Section 262726 – Wiring Devices
- I. Section 262716 – Electrical Cabinets and Enclosures

1.3 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated
- C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
- D. ANSI/NFPA 70 - National Electrical Code
- E. NECA "Standard of Installation"
- F. NEMA RN 1 - Polyvinyl Chloride Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
- G. NEMA TC 2 - Electrical Plastic and Conduit EPC-40 and EPC-80 (PVC)
- H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
- I. NEMA OS-1- Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports
- J. NEMA 250 – Enclosures for Electrical Equipment (1000 volts maximum)
- K. FDOT Standard Specifications for Road and Bridge Construction

1.4 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70, unless otherwise noted or specified (conduit size shall be increased above the minimum requirements of ANSI/NFPA 70 where indicated in this or other sections of these specifications or on the drawings).

1.5 SUBMITTALS

- A. Submit under provisions of Section 260500.

Product Data: Provide shop drawing and catalog data sheets for each type of conduit, fitting, conduit body, raceway seal, and boxes used on the project.
- B. Submit duct bank layout drawings showing sections/elevations for each duct bank.
- C. Contract Closeout

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 260500.
- B. Record actual locations and mounting heights of outlet, pull and Junction Boxes on project record documents.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 260500.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

1.8 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit and boxes prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.
- D. Pull Boxes installed outdoors, in grade, and within the roadway Right of Way will be labeled on the engineering plans with unique labels. i.e. PB1, PB2, etc..

PART 2 - ACCEPTABLE PRODUCTS

2.1 RIGID METAL CONDUIT

- A. Rigid metal conduit (RMC)(GRS)
 - 1. Conduit: ANSI C80.1; Hot dipped galvanized steel. All factory threads shall be galvanized after cutting.
 - 2. Fittings and Conduit Bodies: ANSI/NEMA FB 1; Hot dipped galvanized malleable iron or steel. All fittings shall be threaded and conduit bodies shall have threaded hubs and gasketed covers.

2.2 PVC COATED OR BITUMINOUS COATED RIGID METAL CONDUIT

- A. Rigid Metal Conduit: ANSI C80.1, NEMA RN 1; Hot dipped galvanized steel conduit with a 40mil thick external PVC coating and a 2mil internal urethane coating. All factory threads shall be galvanized and urethane coated after cutting.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; Hot dipped galvanized malleable iron or steel with a 40mil thick external PVC coating and a 2mil internal urethane coating. All fittings shall be threaded and conduit bodies shall have threaded hubs.
- C. Rigid Metal Conduit: ANSI C80.1, NEMA RN 1; Hot dipped galvanized steel conduit with a 40mil thick external Bituminous coating applied in the field. Fittings and threads shall be bituminous coated after installation.

2.3 FLEXIBLE METAL CONDUIT (FMC)

- A. Conduit: ANSI/UL 1; Interlocked steel or aluminum with heavy wall construction. Reduced wall types of FMC is not acceptable.
- B. Fittings: ANSI/NEMA FB 1; Hot dipped galvanized or zinc plated malleable iron or steel, squeeze type connectors with insulated throat. Set screw type connectors are not acceptable.

2.4 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Conduit: ANSI/UL 360; Interlocked hot dipped galvanized steel construction with extruded PVC jacket.
- B. Fittings: ANSI/NEMA FB 1; Compression type with threaded connectors, insulated throat and sealing washers. Hot dipped galvanized or zinc plated malleable iron or steel.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Conduit: ANSI C80.3; Thin wall ferrous steel, hot dipped galvanized with smooth interior reamed ends.
- B. Fittings: ANSI/NEMA FB 1; Hot dipped galvanized malleable iron or steel. Set screw type for dry locations and compression type for all other locations. Fittings for use in wet locations shall be UL Listed for Wet Locations.
- C. Conduit Bodies: ANSI/NEMA FB 1; Hot dipped galvanized malleable iron or steel with threaded hubs and gasketed covers.
- D. Die-cast fittings and conduit bodies are not permissible.

2.6 RIGID NONMETALLIC CONDUIT (PVC)

- A. Conduit: NEMA TC 2; High impact polyvinyl chloride Schedule 40 and 80.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.7 ELECTRICAL NONMETALLIC TUBING (ENT)

- A. The use of ENT is not permitted.

2.8 HIGH DENSITY POLYETHYLENE (HDPE) CONDUIT

- A. HDPE smooth wall conduit shall be manufactured to the following standards: UL 651A and 651B, ASTM F 2160, and NEMA TC-7. The HDPE conduit shall be ‘toneable’ and include a copper conductor within the wall of the duct that will allow locating the buried conduit.
- B. Fittings: Lengths of smoothwall HDPE conduit shall be joined by the Butt Fusion process or by using universal aluminum couplings. Joining PVC conduit to HDPE conduit shall be performed by using PVC to HDPE threaded transition couplings.

2.9 EXPANSION AND DEFLECTION FITTINGS

- A. Fittings: ANSI/NEMA FB 1
 - 1. Metal Conduit Applications: Hot dipped galvanized malleable iron or steel with a 4” expansion chamber, internal tinned copper braided bonding jumper and factory installed packing.
 - 2. Non-Metallic Conduit Applications: Polyvinyl chloride with a 4” expansion chamber and factory installed packing. Fitting wall thickness shall match conduit system application (i.e. schedule 40 or 80.)

2.10 CONDUIT SEALS

- A. Conduit seals for Class 1, Div 1 areas shall be threaded malleable iron type. Seals shall be filled with Class 1, Div 1 sealing compound. Seals shall be Crouse-Hinds type EYS or equivalent approved by the Department.
- B. Conduits penetrating the tunnel walls, floors, or ceilings shall pass through “pipe penetration mechanical seals that provide a gas and waterproof seal.

2.11 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.
 2. Concrete Ceiling Boxes: Concrete type.
- B. Cast Boxes: NEMA FB 1, Type FD, galvanized cast iron. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- C. Wall Plates for Finished Areas: As specified in Section 262726.

2.12 FLOOR BOXES

- A. Floor Boxes: NEMA OS 1, fully adjustable.
- B. Material: Galvanized cast iron
- C. Service Fittings: As scheduled on the drawings.

2.13 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 262716.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
1. Material: Galvanized cast iron
 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Pull Boxes installed outdoors, in grade, and within the roadway Right of Way: Will comply with the latest edition of the FDOT Standard Specifications for Road and Bridge Construction, Section 635 - Pull and Junction Boxes.

PART 3 - EXECUTION

3.1 CONDUITS

- A. Flexible and liquid-tight conduit: 1/2" unless otherwise specified or noted.
- B. Homerun Conduit: 3/4" unless otherwise specified or noted.
- C. Branch Circuit Conduit: 1/2" unless otherwise specified or noted.

- D. Site Electrical Conduit: 1" unless otherwise specified or noted.
- E. Conduit size shall be increased as required for conductor fill, per NFPA 70, when conductor size is increased due to voltage drop as specified in other sections of these specifications.

3.2 GENERAL

- A. All wires for power, lighting, systems, and controls shall be installed in conduit. Conduit shall be of the sizes required to accommodate the number of conductors in accordance with the National Electrical Code, or as noted on the drawings. The sizes shown on the plans may be increased if desired to facilitate the pulling of conductors. The minimum conduit size shall be ¾ inch, unless noted otherwise.
- B. Install conduit in accordance with NECA "Standard of Installation." Perform installation studies prior to rough-in and shall arrange conduit in a neat manner avoiding excessive crossing of conduits.
- C. Install nonmetallic conduit in accordance with manufacturer's instructions.
- D. Generally, all conduit shall be concealed, except in crawl spaces, tunnels, gantries, shafts, equipment rooms, and at connections to surface panels and free standing equipment, or as otherwise noted.
- E. Arrange Conduit (including supports) to maintain headroom, access to equipment and means of egress.
 - 1. Conduits serving equipment more than 24" from a wall shall be roughed-in from underground or over head and serve the equipment vertically within 12" from the equipment. Conduits shall not create a trip hazard around equipment.
 - 2. Conduits shall be routed concealed within ceiling cavities (in all spaces which have a ceiling assembly below the structure) unless specifically indicated as exposed on the drawings.
 - 3. The minimum headroom clearance for exposed conduits within a space shall meet all of the following:
 - a. Install conduit as high as possible
 - b. Install conduit above the bottom of all light fixtures.
 - c. Install conduit at least 6" above the tallest door height (including large doors i.e. roll-up and sliding doors) serving the space.
 - d. In no case shall headroom be less than 7'-0" above the finished floor.
 - e. If a through d above cannot be met and conduit does not serve the space then conduit shall be routed around the space.

- f. If a through e above cannot be met coordinate exact conduit routing with the architect and engineer prior to rough-in and route conduit around required means of egress and per Departments required clearances for the use of the space.
- F. Route exposed conduit parallel and/or perpendicular to walls. Back straps or “stand-offs” shall be used to keep the conduit far enough away from supporting surfaces to allow painting and to prevent the accumulation of dirt and moisture.
- G. Route conduit installed above ceilings parallel and/or perpendicular to the walls.
- H. Conduits in and under slabs may be routed from point-to-point.
- I. Maintain adequate clearance between conduit and piping.
 - 1. No conduit shall be installed less than 2” from piping by other trades or 8” if the pipe is to be insulated. Take responsibility to coordinate the conduit installation with all trades.
- J. Maintain 12 inch (300mm) clearance between conduit and surfaces with temperatures exceeding 104°F (40°C).
- K. Conduits which contain communication, signal, data, control wiring and other wiring sensitive to EMF and RF interference shall be routed at least 12 inches from power conduits and other EMF/RF generating equipment (i.e. light fixture ballast’s, motors, capacitors etc.).
- L. Conduits installed within structural concrete i.e. columns, beams and suspended slabs shall meet all of the following:
 - 1. Conduit shall not be installed within structural concrete until specific written permission is given by the structural engineer. The contractor shall contact the structural engineer in writing within ten days of the award of contract and shall coordinate the installation of conduit within structural concrete. Installation shall meet the structural engineers requirements.
 - 2. Conduit installation within structural concrete shall meet the requirements of applicable building codes.
 - 3. Conduit & outlets which are not indicated on the drawings as being installed within the structural concrete shall be installed outside of the structural concrete (i.e. concealed below slab, above ceiling, within wall cavities or exposed) as indicated.
 - 4. Coordinate and install conduit and outlets within structural concrete where indicated on the drawings unless the requirements of items 1 & 2 above cannot be met. If conduit and outlets cannot be installed within the

structural concrete, as shown then route the conduit outside of the structure at no additional cost. Coordinate routing of conduit outside of the structure with the architect and engineer prior to installation.

- M. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- N. Bring conduit to shoulder of fittings; fasten securely.
- O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coats of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- P. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations.
- Q. Install no more than equivalent of four 90-degree bends (360 degrees) between pull boxes or junction boxes.
 - 1. Limit each bend to 90° or less.
 - 2. For voice, data, fiber optic and video raceway systems:
 - a. Radius of bends shall be 10 times the conduit diameter or greater.
 - b. Use pullboxes to make sharp changes in direction (i.e. around beams). Pullboxes shall be sized to allow required wire bending space for large radius bend of cabling per the cabling manufacturers' recommendations.
 - c. Install no more than equivalent of two 90° bends between boxes.
 - 3. For all other raceway systems (unless noted otherwise in these specifications or on the drawings):
 - a. Radius of bends shall be 6 times the conduit diameter or greater.
 - b. Use conduit bodies to make sharp changes in direction (i.e. around beams).
- R. Avoid moisture traps, where possible; where unavoidable, provide junction box with drain fitting at low points in conduit system.
- S. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, deflection, and expansion joints.
- T. Provide suitable pull string in each empty conduit except sleeves and nipples.
- U. Provide bonding bushings at the end of all conduit stubs which do not terminate into a bonded metal enclosure or junction box (i.e. at terminal boards, cable trays, etc.) bond per 16170.

- V. Seal all conduits with insulating electrical putty, which extend from the interior to the exterior of the building to prevent the circulation of air.
- W. Use a Thruwall waterproof seal on each conduit that penetrates a wall at or below grade level.
- X. Seal conduits entering the building from below grade and all conduits entering hot unconditioned spaces from cool air conditioned spaces with insulating electrical putty to prevent moisture from entering. Slope these conduits away from the building.
- Y. Seal metal conduits entering air conditioned spaces from unconditioned air spaces with insulating electrical putty to prevent moisture from condensing inside the conduit at the point where the conduit enters the cold air conditioned room.
- Z. Install an explosion-proof seal in each conduit run where it enters and leaves a hazardous location.
- AA. Where conduit crosses an expansion joint, an approved expansion fitting for this type of installation shall be installed.
- BB. Flexible conduit - wet locations: Where liquids are present, form drip loops in liquid-tight flexible conduits to prevent liquid from running into connections.
- CC. All raceways, and device boxes in masonry shall be installed at the same time as the masonry.
- DD. All raceways shall be run from outlet to outlet as shown on the drawings, unless permission is granted, in writing from the Engineer, to alter arrangement shown. If permission is granted, arrangement shall be marked on field set of drawings as previously specified.
- EE. Extend homeruns from outlets shown to panel designated, do not combine homeruns, and do not collect homeruns in pull or junction boxes.
- FF. Spare conduit stubs shall be capped and location marked with concrete marker set flush with finish grade. Marker shall be 6" round x 6" deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.
- GG. Use suitable caps to protect installed conduit against entrance of dirt and moisture during construction. Caps shall remain on conduits which remain empty after construction is complete.
- HH. All connections to motors or other vibrating equipment including dry type transformers or at other locations where required shall be made with not less than

12" of flexible steel conduit. Use angle connectors wherever necessary to relieve angle strain on flexible conduit.

- II. Ground and bond conduit under provisions of Section 260526.

3.3 SUPPORTS

- A. Arrange supports to prevent misalignment during wiring installation.
- B. Support conduit using hot dipped galvanized or zinc coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- C. Group related conduits; support using conduit rack. Construct rack using steel channel and allthread provide space on each for 25 percent additional conduits.
- D. Fasten conduit supports to building structure and surfaces under provisions of Section 260529.
 - 1. Electrical conduit system shall be supported independently of all other systems and supports (i.e. duct work, piping, etc.), and shall in every case avoid proximity to other systems which might cause confusion with such systems or might provide a chance of electrolytic actions, contact with live parts or excessive induced heat.
- E. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- F. Do not attach conduit to ceiling support wires.

3.4 APPLICATION

- A. Underground Installations:
 - 1. Site underground raceways may be HDPE conduit or PVC conduit.
 - 2. All conduits or elbows entering, or leaving the ground shall be rigid steel conduit coated with PVC or a bituminous coating.
 - 3. Where rigid metallic conduit is installed underground as noted above it shall be coated with waterproofing bituminous coating before installation, and all joints shall be re-coated after installation.
 - 4. PVC runs over 200 feet in length or 2" c. and larger shall utilize rigid steel elbows or bends with bituminous coating or PVC coating at each riser and change in direction unless indicated otherwise.
- B. In Concrete Slab:

1. Use PVC conduit, unless drawings indicate otherwise.

C. Penetration of Concrete Slab

1. Exposed or Concealed Location:

- a. Where penetrating a floor from underground or in slab, or a column from within the column, a black mastic coated or PVC coated galvanized rigid steel conduit shall be used, starting at a point at least 6" within the floor or column and extending at least 6" out of the slab or column. Where conduits are grouped together in an exposed location, the rigid steel conduit penetrations shall terminate at the same length in the first coupling or connector.

D. Outdoor Location:

1. Above Grade:

- a. Where penetrating the finished grade, bituminous coated or PVC coated galvanized rigid metal conduit shall be used, beginning 6" below grade.
- b. In general, all exposed exterior conduit runs shall be galvanized rigid steel conduit with threaded connections.
- c. Exposed exterior conduit shall be painted as directed by the Architect.

2. Metal Canopies:

- a. Conduit runs shall not be installed on the top side of metal canopies roof systems.

3. Roofs:

- a. Conduit is not to be installed on roofs, without written authorization by the Engineer for specific conditions.
- b. When approved by written authorization conduit shall comply with the following:
 - (1) Shall be rigid galvanized metal conduit.
 - (2) Conduit shall be supported above roof at least 6 inches using approved conduit supporting devices. Refer to applicable sections of specifications on roofing, etc.
 - (3) Supports to be fastened to roof using roofing adhesive or means as approved by roofing contractor.

E. Interior Dry Locations:

1. Concealed: Use rigid galvanized steel and electrical metallic tubing, unless drawings indicate otherwise.
2. Exposed: Use rigid galvanized steel and electrical metallic tubing, unless drawings indicate otherwise.
3. Concealed or exposed flexible conduit:
 - a. Flexible steel conduit or seal tight flexible steel conduit in lengths not longer than six (6) feet in length with a ground conductor installed in the conduit.

F. Interior Wet and Damp Locations:

1. Use rigid galvanized steel conduit.
2. The gantry structure is considered a wet location.

G. Concrete Columns or Poured in-place Concrete Wall Locations:

1. Use thickwall non-metallic conduit. Penetration shall be by approved metal raceway (i.e., metal conduit as required elsewhere in these specifications).

H. Underground Concrete Duct Bank:

1. Provide SCH 40 PVC conduit, encased in concrete with at least three inches of concrete at the top and bottom and two inches on each side. The minimum cover (below grade) to the top of a duct bank shall be 24 inches. A horizontal and vertical separation between the ducts of 1 inch or 1-1/2 inches (as required) shall be maintained by installing high impact spacers with horizontal and vertical locking intervals of 8 feet. Provide reducers for 1 inch and 3/4 inch conduits. Concrete shall be minimum 2,500 psi strength at 28 days; 1/2 inch maximum aggregate size. Duct bank shall extend inside the building below the slab as shown on Drawings. Duct bank conduits shall have a continuous slope downward toward the associated pull boxes and away from buildings with a minimum pitch of 3 inches in 100 feet.
2. Products: Provide the following duct bank spacers as manufactured by Carlon Power & Telecom Systems or equivalent:
 - a. Base spacers shall be Series S288.
 - b. Intermediate spacers shall be Series S289.
 - c. Reducers shall be Series S287.
3. Pull boxes associated with the duct bank shall be open bottom type.

4. Prior to installation, submit a duct bank section layout identifying each conduit within duct bank, including reduction of conduits at each island and reduction of duct bank size as required by conduit count.

3.5 ADDITIONAL REQUIREMENTS FOR SITE ELECTRICAL UNDERGROUND CONDUIT

- A. Routing of conduits shall be coordinated with the civil, hardscape and landscape construction documents and installers.
 1. Conduit shall be installed in accordance with Article 300 of the NEC except the minimum cover for any conduit shall be 2 feet.
 2. Conduit must maintain a minimum of 1ft. clearance with parallel utilities and at utility crossings.
 3. Conduit must maintain a minimum of 1ft. clearance with footers, foundations and tree root balls.
 4. Conduit shall be routed around tree save areas and retention ponds
 5. Conduits crossing under drainage ditches or swales shall be provided with a 4" thick concrete cap (minimum 12" wide). The concrete cap shall extend 5ft. beyond the width of the ditch.
 6. HDPE Conduit shall be colored red for power distribution conductors and orange for CCTV and security system.

3.6 ADDITIONAL REQUIREMENTS FOR RIGID STEEL CONDUIT

- A. All connections shall be threaded. The use of an Erickson type coupling is acceptable where two segments of a run must be joined and neither can be rotated. Non-threaded type connectors shall not be allowed.
- B. A threaded insulated bushing shall be provided at all conduit terminations.
- C. Rigid steel conduit shall be used for all cables rated over 600 volts in exposed locations.

3.7 ADDITIONAL REQUIREMENTS FOR EMT

- A. Electric metallic tubing (thin wall) may be installed inside buildings above slab on grade in dry locations where not subject to mechanical injury. If subject to mechanical injury, rigid galvanized steel conduit shall be used.
- B. All cuts shall be reamed smooth and free of sharp and abrasive areas by use of an approved reamer.

3.8 ADDITIONAL REQUIREMENTS FOR NON-METALLIC CONDUIT (PVC CONDUIT)

- A. PVC conduit is not allowed anywhere inside building(s) except underground, in slab, or in poured in place concrete.
- B. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- C. Threads will not be permitted on PVC conduit.
- D. Installation of PVC conduit shall be in accordance with manufacturer's recommendations.
- E. PVC conduit shall not be used to support fixtures or equipment.
- F. Field bends shall be made with approved hotbox. Heating with flame or hand held dryers is prohibited.
- G. PVC conduit shall not be used in exposed locations.
- H. PVC conduit 2 inches and larger installed below grade will utilize galvanized rigid metal conduit elbows. Rigid metal conduit installed below grade will be PVC coated or bituminous coated.

3.9 ADDITIONAL REQUIREMENTS FOR THE PRIMARY CONDUIT SYSTEM

- A. Shall meet all utility company requirements.
- B. Shall be 6" conduit for medium voltage cabling unless noted otherwise.
- C. Shall be 1-1/2" conduit for low voltage control cabling.
- D. Shall be non-metallic conduit (Schedule 40) for underground locations.
- E. All bends in 6" conduit shall have a 48" radius. All bends in 4" conduit or smaller shall have a 36" radius.
- F. All conduits or elbows entering or leaving the ground in exposed locations (i.e. at pole base) shall be rigid steel conduit.
 - 1. Conduits terminating within transformers, pullboxes or switchgear shall not be considered exposed.
- G. Provide polyester pull rope in all empty conduit raceways and provide tag at each end labeling the destination of the conduit.

- H. Provide underground warning tape: 4 inch wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines. Install warning tape 12" below grade directly above each primary conduit.
- I. All underground conduit shall have a minimum of three feet of cover.
- J. All conduit must maintain a minimum of 1ft. clearance with parallel utilities and at utility crossings.
- K. Conduit must be a minimum of 3ft. from property line, foundations, footer, tree balls, and retention ponds.

3.10 GROUNDING

- A. All raceways shall have a copper system ground conductor throughout the entire length of circuit installed within conduit in strict accordance with NEC codes.
- B. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings.
- C. Grounding electrode conductors (including lightning protection down conductors) run in metal conduit shall be bonded to the metal conduit at both ends using bonding bushings.

3.11 VERTICAL RACEWAYS

- A. Cables in vertical raceways shall be supported as per NEC Article 300.19. Provide and install supporting devices for cables, including any necessary accessible pullbox as required regardless if shown on drawings or not. Provide and install access panels as required. Coordinate location of pullbox and access panel with architect prior to installation. This includes empty raceways for future use.

3.12 FIRESTOPPING

- A. All penetrations through fire resistance rated partitions and other assemblies, including empty openings and openings containing cables, conduits and other penetrating items, shall be fire-stopped to preserve the fire resistance rating of the assembly. Fire-stopping shall comply with the following:
 - 1. Compatibility: Provide fire-stopping composed of Components that are compatible with each other, the substrates forming openings, and the items if any, penetrating the fire-stopping under conditions of service and application, as demonstrated by fire-stopping manufacturer based on testing and field experience.

2. Fire-stopping shall be listed in the underwriters laboratories fire resistance directory and installation shall be identical to that shown in the directory.
3. Fire-stopping details shall be submitted and approved by the Architect, Engineer and authority having jurisdiction prior to installation.

B. System Performance Requirements

1. General: Provide fire-stopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.
 2. F-Rated Through-Penetration Fire-stop Systems: Provide through-penetration fire-stop systems with F ratings equaling or exceeding the fire resistance rating of the constructions penetrated, as determined per ASTM E 814.
 3. T-Rated Through-Penetration Fire-stop Systems: Provide through-penetration fire-stop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where systems protect floor penetrating items exposed to contact with adjacent materials such as:
 - a. Where fire-stop systems protect penetrations located outside of wall cavities.
 - b. Where fire-stop systems protect penetrations located outside fire-resistive shaft enclosures.
 - c. Where fire-stop systems protect penetrations located in construction containing doors required to have a temperature-rise rating, whether or not penetration is located within wall cavity.
 - d. Where fire-stop systems protect penetrating items larger than a 4" diameter nominal pipe or 16 sq. in. in overall cross-sectional area, whether or not penetration is located within a wall cavity.
- C. For fire-stopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 50, as determined per ASTM E 84.
- D. Fire-stopping shall meet the requirements of applicable building codes as determined by the authority having jurisdiction.
- E. Installer Qualifications: Engage an experienced Installer who is certified, licensed, or otherwise qualified by the fire-stopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements.

- F. Provide fire-stopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."
- G. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that through-penetration fire-stop systems are installed per specified requirements.

3.13 ROOF MEMBRANE PENETRATION

- A. Route conduit through roof openings for piping and ductwork or through suitable weatherproof boot. Coordinate the location and penetration requirements with the Roofing Contractor. Roof penetrations shall meet all requirements of the roofing specifications. Provide fire-stopping of rated roof structure assemblies.

3.14 BOXES

- A. Verify locations of floor boxes, pull boxes, and outlets prior to rough-in.

3.15 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation".
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet (3 m) if required to accommodate intended purpose.
- E. Orient boxes to accommodate wiring devices oriented as specified in Section 262726.
- F. Maintain headroom and present neat mechanical appearance.
- G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.

- I. Install boxes to preserve fire resistance rating of partitions and other elements, using UL Listed materials and methods.
- J. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- K. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- L. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- M. Use flush mounting outlet box in finished areas.
- N. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- O. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches (150 mm) separation. Provide minimum 24 inches (600 mm) separation in fire rated or acoustic rated walls, or provide firestopping and/or acoustic treatment where boxes cannot be separated.
- P. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- Q. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- R. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- S. Use adjustable steel channel fasteners for hung ceiling outlet box.
- T. Do not fasten boxes to ceiling support wires.
- U. Support boxes independently of conduit.
- V. Use one piece gang box where more than one device is mounted together. Do not use sectional box.
- W. Use gang box with plaster ring for single device outlets.
- X. Use galvanized cast iron outlet box in exposed locations.
- Y. Use galvanized cast iron floor boxes for installations in slab on grade.
- Z. Set floor boxes level.

- AA. All exterior boxes shall be weather proof type with weather proof covers.
- BB. Large Pull Boxes: Use hinged enclosure, refer to section 262716.
- CC. Use galvanized cast iron boxes for toll equipment outlets/junction boxes cast in concrete.
- DD. Pull Boxes installed outdoors, in grade, and within the roadway right of way will be installed in accordance with FDOT design standards 17721 – Conduit Installation Details.

3.16 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate installation of outlet box for equipment connected under Section 260520.

3.17 ADJUSTING

- A. Contract Closeout
- B. Adjust floor box flush with finish flooring material.
- C. Adjust flush-mounting outlets to make front flush with finished wall material.
- D. Install knockout closures in unused box openings.

3.18 CLEANING

- A. Contract Closeout: Cleaning installed work.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION 260533

SECTION 260534 - SURFACE RACEWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Multi-outlet assemblies
- B. Wireways

1.2 RELATED SECTIONS

- A. Section 262726 - Wiring Devices: Receptacles.

1.3 REFERENCES

- A. NECA (National Electrical Contractor's Association) Standard of Installation.
- B. NEMA WD 6 - Wiring Device Configurations.

1.4 SUBMITTALS

- A. Submit under provisions of Section 260500.
- B. Product Data: Provide dimensions, knockout sizes and locations, materials, fabrication details, finishes, and accessories.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.
- B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years experience.

PART 2 - PRODUCTS

2.1 MULTI-OUTLET ASSEMBLY

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturer will be considered.)
 - 1. Wiremold
- B. Multi-outlet Assembly: Sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as multi-outlet assembly.
- C. Size: As indicated on Drawings.
- D. Receptacles: NEMA WD 6, type 5-15R, single receptacle.
- E. Receptacle Spacing: 6 inches on center.
- F. Receptacle Color: Ivory
- G. Channel Finish: Gray
- H. Fittings: Furnish manufacturer's standard couplings, elbows, outlet and device boxes, and connectors.

2.2 WIREWAY

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturer will be considered.)
 - 1. Hoffman
 - 2. Cooper B-Line
- B. Description:
 - 1. Interior Dry Locations - General Purpose, NEMA Type 1
 - 2. Damp or Wet Locations - NEMA Type 4X,
- C. Knockouts: None
- D. Size: As indicated on Drawings.
- E. Cover: Hinged cover with full gasketing in wet locations.
- F. Connectors and Fittings: Slip-in type with captive screws and removable sides to allow complete lay-in wiring.

G. Finish:

1. NEMA 1 Wireway - ANSI -49 gray epoxy paint applied by an E-coat process per UL 870
2. NEMA 4X – Natural stainless steel or fiberglass.

PART 3- EXECUTION

3.1 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.
- C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- D. Wireway Supports: Provide steel channel as specified in Section 260529.
- E. Close ends of wireway and unused conduit openings.
- F. Ground and bond raceway and wireway under provisions of Section 260526.

END OF SECTION 260534

SECTION 260536 - CABLE TRAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cable trays and accessories.

1.2 RELATED SECTIONS

- A. Firestopping.
- B. Section 260526 - Grounding and Bonding.
- C. Section 260529 – Hangers and Supports for Electrical Systems

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. ASTM A 123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
- C. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process.
- D. NEMA VE 1 - Metallic Cable Tray Systems.

1.4 SUBMITTALS FOR REVIEW

- A. Section 260501 - Submittals: Procedures for submittals.
- B. Product Data: Provide data for fittings and accessories.
- C. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 260500 - Submittals: Submittals for information.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout
- B. Project Record Documents: Record actual routing of cable tray and locations of each support.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience, and with service facilities within 100 miles of Project.

1.8 PRE-INSTALLATION MEETING

- A. Coordination and Meetings: Pre-installation meeting.
- B. Convene one week prior to commencing work of this section.

1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings, instructed by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (or equivalent)

- A. B-Line Systems, Inc.
- B. P-W Industries, Inc.
- C. MP Husky Corporation

2.2 LADDER-TYPE CABLE TRAY

- A. Description: NEMA 12A and 8C classification with NEMA VE 1 loading depth,.
- B. Material: Aluminum Association Alloy 6063-T6
- C. Finish: Anodized
- D. Inside Width: 24 inches
- E. Inside Depth: 4 inches
- F. Straight Section Rung Spacing: 6 inches on center.

- G. Inside Radius of Fittings: 12 inches
- H. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

2.3 WARNING SIGNS

- A. Engraved Nameplates: 1/2-inch black letters on yellow laminated plastic nameplate, engraved with the following wording:

WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install metallic cable tray in accordance with NEMA VE 1.
- B. Support trays in accordance with Section 260529. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 ft maximum.
- C. Use expansion connectors where required where joints are crossed.
- D. Provide UL Listed firestopping to sustain the wall fire ratings when passing cable tray through fire-rated elements and partitions.
- E. Ground and bond cable tray under provisions of Section 260526.
 - 1. Provide continuity between tray components.
 - 2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
 - 3. Provide 2 AWG bare copper equipment grounding conductor through entire length of tray; bond to each tray section and component.
 - 4. Connections to tray to be made using mechanical connectors.
 - 5. Bond all metallic conduit terminating at the tray with a bonding bushing and #8 AWG copper to the tray equipment grounding conductor.
- H. Install warning signs at 50 feet centers along cable tray, located to be visible.
- I. Carefully coordinate the cable tray installation with other trades to avoid interferences and maintain proper NEC clearances.
- J. Install to create a continuous, low-resistance, electrical ground return path in accordance with the requirements of the NEC.

- K. Install at locations and heights indicated and at locations required by field connections.
- L. Provide short section of tray covers at all openings in walls for passage of cable tray unless otherwise indicated. Grout-in openings around cable tray after installations.
- M. Cable tray wire shall not be spliced at the tray or inside the tray.
- N. Cable tray installed outside will utilize screw on covers to protect the cables from the elements.

END OF SECTION 260536

SECTION 260543 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Concrete Ductbank

1.2 RELATED SECTIONS

- A. Earthwork
- B. Cast-In-Place Concrete
- C. Section 260533 – Raceways and Boxes for Electrical Systems

1.3 SUBMITTALS FOR REVIEW

- A. Section 260501 - Submittals
- B. Shop Drawings: Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Project Record Documents: Record actual routing and elevations of underground conduit and duct, and locations and sizes of manholes.

1.5 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.
- B. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- C. Verify locations of manholes prior to excavating for installation.
- D. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to form a complete duct system.
- E. Manhole locations are shown in approximate locations unless dimensions are indicated. Locate as required to complete ductbank system.

PART 2 - PRODUCTS

2.1 PLASTIC CONDUIT

- A. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC, with fittings and conduit bodies to NEMA TC 3.

2.2 ACCESSORIES

- A. Underground Warning Tape: 4 inch wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 DUCT BANK INSTALLATION

- A. Install duct to locate top of ductbank at depths as indicated on drawings.
- B. Install duct with minimum slope of 3 inches per 100 feet Slope the duct away from building entrances.
- C. Cut duct square using saw or pipe cutter; de-burr cut ends.
- D. Insert duct to shoulder of fittings; fasten securely.
- E. Join nonmetallic duct using adhesive as recommended by manufacturer.
- F. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- G. Install no more than equivalent of three 90-degree bends between pull points.
- H. Provide suitable fittings to accommodate expansion and deflection where required.
- I. Terminate duct at manhole entries using end bell.
- J. Stagger duct joints vertically in concrete encasement 6 inches minimum.
- K. Use suitable separators and chairs installed not greater than 4 feet on centers.
- L. Securely anchor duct to prevent movement during concrete placement.
- M. Place concrete under provisions of Cast In Place Concrete.
- N. Provide minimum 3-inch concrete cover at bottom, top, and sides of ductbank.

- O. Provide two No. 4 steel reinforcing bars in top of bank under paved roads.
- P. Connect to existing concrete encasement using dowels.
- Q. Connect to manhole wall using dowels.
- R. Provide suitable pull string in each empty duct except sleeves and nipples.
- S. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.
- T. Backfill trenches.
- U. Install an underground detectable warning tape above the duct bank when backfilling.

END OF SECTION 260543

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels
- B. Wire and cable markers
- C. Conduit markers

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code

1.3 SUBMITTALS

- A. Submit under provisions of Section 260500.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., and acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Nameplates shall be laminated phenolic plastic, chamfer edges, black front and back with white core, with lettering etched through the outer covering. White engraved letters on black background.
- B. Nameplates for emergency power (where applicable) shall be laminated phenolic plastic. Red front and back, with white core, with lettering etched through outer covering, white engraved letters on red background.

C. Letter Size:

1. Use 1/4 inch high letters for identifying individual equipment and loads.
2. Use 1/2 inch high letters for identifying grouped equipment and loads.
3. Use 1 inch high letters for identifying Service Disconnecting means.

D. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown and shop drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 120/208V, 3-phase, 4-wire". In addition, provide phenolic label in panel to describe where the panel is fed from. For example, "Fed from MDP-1:3:5". The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine.

E. The following items shall be equipped with nameplates: All motors, motor starters, motor-control centers, push button stations, control panels, time switches, disconnect switches, transformers, panelboards, circuit breakers (i.e. all 2 pole, 3 pole C.B.'s), contactors or relays in separate enclosures, power receptacles where the nominal voltage between any pair of contacts is greater than 150V, wall switches controlling outlets that are not located within sight of the controlling switch, high voltage boxes and cabinets, large electrical systems junction and pull boxes (larger than 4 11/16"), terminal cabinets, terminal boards, and equipment racks. Nameplates shall also describe the associated panel and circuit number (if applicable).

F. Field install Arc Flash and Shock Warning labels on each piece of new electrical distribution equipment such as panelboards, safety switches, motor control centers, and automatic transfer switches. The labels will indicate the flash hazard boundry, the flash hazard at 18 inches, the PPE level requirements, and the approach restrictions.

G. All Electrical System panels, transfer switches, etc. shall be labeled as per branch, i.e., "Panel ABC-Life Safety Branch" (similar for critical or equipment branch).

H. Provide adhesion labels on inside door of each fused switch indicating NEMA fuse classification and the size fuse installed.

I. All Electrical Emergency System panels, transfer switches, etc. shall be labeled as per branch as defined by NEC, i.e., labeling shall be:

1. "Panel (****)-Emergency Life Safety Branch" for Emergency systems per NEC Article 700.

2. "Panel (****)-Legally Required Standby Branch" for Emergency systems per NEC Article 701
3. "Panel (****)-Optional Standby Branch" for Emergency systems per NEC Article 702
4. Provide label on interior of each Electrical Emergency panel as follows:
 - a. Each Emergency Life Safety Branch panelboard label shall read: "WARNING: PANEL SHALL BE DEDICATED TO THE INSTALLATION OF EMERGENCY BRANCH WIRING AS DEFINED BY NEC-700/NFPA-110 AS ESSENTIAL FOR SAFETY TO HUMAN LIFE. CONNECTION OF OTHER LOADS/EQUIPMENT NOT DEFINED BY NEC IS PROHIBITED".
 - b. Each Emergency Legally Required Standby Branch panelboard label shall read: "WARNING: PANEL SHALL BE DEDICATED TO THE INSTALLATION OF EMERGENCY LEGALLY REQUIRED BRANCH WIRING AS DEFINED BY NEC-701/NFPA-110 WHEN INTERRUPTION COULD CREATE HAZARD OR HAMPER FIRE-FIGHTING OPERATION. CONNECTION OF OTHER LOADS/EQUIPMENT NOT DEFINED BY NEC IS PROHIBITED".
 - c. Each Emergency optional Standby Branch panelboard label shall read: "WARNING: PANEL SHALL BE DEDICATED TO EQUIPMENT OWNER DESIRES TO BE ON EMERGENCY THAT IS NOT DEFINED BY NEC-700/NEC-701/NFPA-110 AS EMERGENCY LIFE SAFETY OR EMERGENCY LEGALLY REQUIRED. CONNECTION OF OTHER LOADS/EQUIPMENT DEFINED BY NEC 700/701 IS PROHIBITED".

2.2 WIRE MARKERS

- A. Description: Cloth, tape, split sleeve, or tubing type wire markers.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
- C. Legend:
 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings including neutral conductor.

2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on shop drawings.

2.3 CONDUIT/JUNCTION BOX COLOR CODE

- A. All conduit system junction boxes (except those subject to view in public areas) shall be color coded as listed below:

Color Code for Junction Boxes	Krylon Paint #
System Emergency 277/480 volt	Cherry Red 2101
System Emergency 120/208 volt	Light Red 2110
Fire Alarm	Popsicle Orange 2410
Normal Power 277/480 volt	Leather Brown 2501
Normal Power 120/208 volt	Glossy Black 1601
Fiber Optics	Plum Purple 1929
Sound System	Daisy Yellow 1813
Clock	Baby Blue 1902
Intercom	True Blue 1910
Computer/Data	Gold 1701
TV	Glossy White 1501
BAS	Light Beige 2502
FIDS / BIDS	Beige 2504
Security/CCTV	Moss Green 2004
Telephone	Light Green 2011
Grounding	Fluorescent Green #3106

- B. Conduits (not subject to public view) longer than 20 feet shall be painted with above color paint band 20 ft. on center. Paint band shall be 4" in length. Where conduit are parallel and on conduit racking, the paint bands shall be evenly aligned. Paint shall be neatly applied and uniformed. Paint boxes and raceways prior to installation or tape conduits and surrounding surfaces to avoid overspray. Paint overspray shall be removed.

- C. Junction boxes and conduit located in public areas (i.e. areas that can be seen by the public) shall be painted to match surface attached to. Provide written request to A/E for interpretation of those public areas which may be in question.

2.4 CONDUIT/JUNCTION BOX MARKER

- A. All new and existing junction boxes/cover plates for power, lighting and systems (except those installed in public areas) shall adequately describe it's associated panel and circuit reference number(s) within, (i.e. ELRW-2, 4, 6) or systems within (i.e. fire alarm, intercom, etc.). Identification shall be by means of black permanent marker. (Paint 1/2 cover plate with appropriate color as noted in 2.3 above, and mark other 1/2 with associated panel/circuit or system description as described).
- B. Identify conduit not installed in public areas with circuit numbers as described above. Spacing: 20 ft. on center, adjacent to color identification bands.

2.5 DEVICE COVER PLATE IDENTIFICATION

- A. Self-adhesive clear printed labels with Black typed letters (pre-printed, dot matrix, or laser). Labels printed with Ink Jet printers are not acceptable
- B. Locations:
 - 1. Each new receptacle cover plate.
 - 2. Each existing receptacle cover plate in areas of remodel/renovation.
 - 3. Each new communications cover plate (Systems Sections 271000 through 275000).
 - 4. Each existing communications cover plate (Systems Sections 271000 through 275000) in areas of remodel/renovation.
 - 5. Fire alarm system control modules, monitor modules and remote test stations.
 - 6. Each connection to modular office furniture system.
- C. Legend:
 - 1. Receptacle plates adequately describe its associated panelboard and circuit reference (i.e., L1A-3).
 - 2. System plates adequately describe its terminal board, or terminal cabinet, termination cable identifier, and assigned user code number, (i.e., TTB-LS2-***).
 - 3. Fire alarm control devices adequately describe item severed and assigned address, if addressable, (i.e., AHU-1 Supply ID 12345-***).

2.6 UNDERGROUND WARNING TAPE

- A. Description: 4 inch wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines.

2.7 SIGNAGE

- A. Description: Laminated phenolic plastic, chamfer edges, white core, face color as specified elsewhere, with lettering etched through the outer covering, 1" lettering.
- B. Locations:
 - 1. More than one service per 2008 NEC 230.2 (if applicable).
 - 2. Emergency Generator Systems per 2008 NEC 700.8 (if applicable).
 - 3. Electrical Fire Pump Systems per 2007 NFPA-20, Chapter 9 (if applicable).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates.

3.2 APPLICATION

- A. Install nameplate parallel to equipment lines.
- B. Secure nameplate to equipment front using stainless steel pop rivets.
- C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- D. Paint colored band on each conduit longer than 6 feet (2 m).
- E. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches below finished grade.
- F. Identify junction boxes and outlet boxes.
- G. Nameplates installed inside on dead front cover shall be self adhesive tape. (Do not drill or install screws in dead front unless prior approval is granted by equipment manufacture).
- H. Install wire markers at all connections and terminations.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Lighting Contactors
- B. Relays and Control Devices
- C. Enclosures
- D. Furnish and install a complete system for the control of lighting and other equipment as indicated on the plans and as further defined herein.

1.2 REFERENCES

- A. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies
- C. NFPA 70 - National Electrical Code

1.3 SUBMITTALS

- A. Section 260501 – Shop Drawing Requirements
- B. Shop Drawings: Submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, DTC, photocells and other interfaces. Drawings to indicate exact location of each device.
- C. Product Data: Submit manufacturer's data on the specific lighting control system and components. Submit a complete bill of materials with part numbers, description and voltage specifications.
- D. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component if it differs from that illustrated in the riser diagram in these specifications. Submittals that show typical riser diagrams are not acceptable.

1.4 QUALITY ASSURANCE

- A. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.

- B. Lighting control panels shall be listed to UL 916. Emergency circuits shall be listed to UL 924.

1.5 MAINTENANCE MATERIALS

- A. Provide 4 spare relays per LCP, except for Micro panels.
- B. Provide operating manuals.

PART 2 - PRODUCTS

2.1 MATERIAL AND COMPONENTS

- A. Lighting Control Panels: Panels shall be made up of the following components:
 - 1. NEMA rated enclosure with screw cover or hinged door. Rain tight or oil tight and other NEMA rated versions available.
 - 2. 16 AWG steel barrier shall separate the high voltage and low voltage compartments of the panel.
- B. Standard Output Relays
 - 1. Electrically held, electronically latched SPST relay.
 - 2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #10AWG wires on both the line and the load side. Systems that do not allow for individual relay replacement or additions are not acceptable.
 - 3. Rated at 20 Amp, 277VAC Ballast, Tungsten, HID, 1 HP at 120 Vac, 2 HP at 240 Vac.
 - 4. Relays to be rated for 250,000 operations minimum at 20a lighting load, use Zero Cross circuitry and be Normally Closed (NCZC). All incandescent circuits shall be energized by use of a Normally Closed SoftStart™ (NCSS) relay rated at 100,000 operations at full 20a load. No exceptions.
- C. DTC - Digital Electronic Time Clock
 - 1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept interface inputs.

2. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.
 3. The DTC shall be run from non-volatile memory so that all system programming and real time clock functions are maintained for a minimum of 15 years with loss of power.
 4. DTC shall provide system wide timed overrides. Any relay, group or zoned that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.
- D. Interfaces: For future expansion capability, system to have available all of the following interfaces. Verify and install only those interfaces indicated on the plans.
1. A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card.
 2. An exterior (PCO) or interior (PCI) photocell that provides readout on the DTC screen in number values analogous to foot-candles. Each photocell shall provide a minimum of 14 trigger points. Each trigger can be programmed to control any relay or zone. Each trigger shall be set through programming only. Photocells which requires the use of setscrews or which must be programmed at the photocell control card shall be not acceptable.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Mount relay control cabinets adjacent to respective lighting panelboard. Cabinet shall be surface or flush mount, per plans. Wiring between relay control cabinet and panelboards to be per local codes and acceptable industry standards. Neatly lace and rack wiring in cabinets. During construction process, protect all interior components of each relay panel and each digital switch from dust and debris.
- B. Wiring
1. Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
 2. Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.

3. Neatly lace and rack wiring in cabinets.

3.2 DOCUMENTATION

- A. Each relay shall have an identification label indicating the originating branch circuit number and panelboard name along with the relay number as indicated on the drawings. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.
- B. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the identification number for that relay, placement of switches and location of photocell. Original to be given to the Department, copies placed inside the door of each LCP.

3.3 CLEANING

- A. Remove dirt and debris from all LCP enclosures.
- B. Clean photocell lens as recommended by manufacturer.
- C. Clean all switch faceplates.

END OF SECTION 260923

SECTION 262213 – LOW VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Dry Type, Air Cooled, Two-winding transformers

1.2 RELATED SECTIONS

- A. Section 260533 – Raceways and Boxes for Electrical Systems: Flexible conduit connections.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.

1.3 REFERENCES

- A. NEMA ST 20 - Dry-Type Transformers
- B. NEMA TP1 – 2002: The Guide for Determining Energy Efficiency for Distribution Transformers.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association)
- D. NFPA 70 - National Electrical Code
- E. UL 1561

1.4 SUBMITTALS FOR REVIEW

- A. Section 260500 - Submittals: Procedures for submittals.
- B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 260500 - Submittals: Submittals for information.
- B. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

- C. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout
- B. Record actual locations of transformers in project record documents.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Material and Equipment: Transport, handle, store, and protect products.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS (General Purpose, Dry Type)

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)
 - 1. Square D Company
 - 2. General Electric
 - 3. Cutler Hammer
- B. Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated on the plans.
- C. General purpose dry type transformers will meet the requirements of Public Law 109-58 of the Energy Policy Act of 2005.
- D. Insulation system and average winding temperature rise for rated kVA as follows:

1. 1-15 kVA: Class 185 with 115°C rise.
 2. 16-1000 kVA: Class 220 with 150°C rise.
- E. Case temperature: Do not exceed 35°C rise above ambient at warmest point at full load.
- F. Winding Taps:
1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 2. Transformers 15 kVA and larger: shall have a minimum of 6 - 2.5% full capacity primary taps for 480V primaries and a minimum of 2 - 5% full capacity taps for 208V primaries.
- G. Sound Levels: Maximum sound levels are as follows:
1. 15-50 kVA: 45 dB
 2. 51-150 kVA: 50 dB
 3. 151-300 kVA: 55 dB
 4. 301-500 kVA: 60 dB
 5. 501-700 kVA: 62 dB
 6. 701-1000 kVA: 64 dB
- H. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
- I. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- J. Mounting:
1. 1-15 kVA: Suitable for wall mounting.
 2. 16-75 kVA: Suitable for floor or trapeze mounting.
 3. Larger than 75 kVA: Suitable for floor or trapeze mounting.
- K. Coil Conductors: Continuous windings with terminations brazed or welded.
- L. Enclosure: Type 1 for dry locations, Type 3R with weather shield for damp or exterior locations. Provide lifting eyes or brackets.
1. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges

and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be ANSI 49.

- M. Isolate core and coil from enclosure using vibration-absorbing mounts.
- N. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.
- O. Lugs: Suitable for terminating conductors sized for full load ampacity of transformer unit. Transformer lugs and mounting hardware shall be furnished by Manufacturer of transformer and shall be grade 5 with beveled washers. Hardware shall be of suitable size of pad opening per NEMA Standards.

2.2 SOURCE QUALITY CONTROL

- A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide General Purpose type transformer unless noted otherwise.
- B. Provide concrete housekeeping pad for floor mounted transformers, pad shall be 4" high and shall extend 4" beyond the sides and front of the transformer. Mount transformer off of wall per the manufactures' recommendation to allow proper ventilation of the transformer (4" minimum).
- C. Set transformer plumb and level.
- D. Use flexible conduit, under the provisions of Section 260533, 2 feet (600 mm) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
- F. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- G. Mount trapeze-mounted transformers as indicated. Provide spring vibration isolators suitable for isolating the transformer noise from the building structure.
- H. Provide grounding and bonding in accordance with Section 260526.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.2.

3.3 ADJUSTING

- A. Contract Closeout: Testing, Adjusting, and Balancing: Adjusting installed work.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION 262213

SECTION 262413- SWITCHBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Switchboards
- B. Switchboard accessories

1.2 RELATED SECTIONS

- A. Section 260526 - Grounding and Bonding
- B. Section 262713 - Utility Service Entrance
- C. Section 262813 - Fuses

1.3 REFERENCES

- A. ANSI C12 - Code for Electricity Metering
- B. ANSI C39.1 - Requirements for Electrical Analog Indicating Instruments
- C. ANSI C57.13 - Requirements for Instrument Transformers
- D. NEMA AB 1 - Molded Case Circuit Breakers
- E. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- F. NEMA PB 2 - Dead Front Distribution Switchboards
- G. NEMA PB 2.1 - Instructions for Safe Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less
- H. NEMA 260 - Safety Labels for Padmounted Switchgear and Transformers Sited in Public Areas
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association)
- J. NFPA 70 - National Electrical Code

1.4 SUBMITTALS FOR REVIEW

- A. Section 260500 - Submittals: Procedures for submittals.
- B. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.
- C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral and ground; and switchboard instrument details.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 260500 - Submittals: Submittals for information.
- B. Test Reports: Indicate results of factory production tests.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
- D. Shop drawings for each Electrical Room, scaled $\frac{1}{2}'' = 1'$ showing the physical location of each switchboard in relation to other electrical and mechanical equipment in the room.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout
- B. Record actual locations of switchboard in project record documents.
- C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in 48 inch (1 219 mm) maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

1.10 MAINTENANCE MATERIALS

- A. Contract Closeout
- B. Furnish two of each key.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)

- A. Square D Co.
- B. General Electric
- C. Cutler-Hammer

2.2 SWITCHBOARD

- A. Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.
- B. Integrated Symmetrical short circuit ratings:
 - 1. All panelboards, bussing and circuit breakers shall be fully rated to safely interrupt the available short circuit current at their terminals. The AIC ratings shown on the drawings are the minimum ratings that can be provided.
 - 2. Contact the power company, in writing, within 10 days of the award of the contract to verify the actual available short circuit amps (SCA) available at the utility transformer secondary bushings. Provide electrical distribution and utilization equipment with AIC ratings or With-Stand Ratings (WSR) greater than the available SCA at each point in the electrical system.

- C. Main Section Devices: Individually mounted and compartmented.
- D. Distribution Section Devices: Panel mounted.
- E. Bus Material: Copper with tin plating.
- F. Bus Connections: Bolted, accessible from front for maintenance.
- G. Ground Bus:
- H. Molded Case Circuit Breakers: NEMA AB 1, integral thermal and instantaneous magnetic trip in each pole.
 - 1. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
 - 2. Include shunt trip, where indicated on plans.
- I. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 rms amperes symmetrical let-through current and energy level less than permitted for same size Class RK-5 fuse. Include shunt trip, where indicated.
- J. Solid-state Molded Case Circuit Breakers: NEMA AB 1, with electronic sensing, timing and tripping circuits for adjustable current settings.
 - 1. Ground fault trip, ground fault sensing integral with circuit breaker.
 - 2. Instantaneous trip.
 - 3. Adjustable short time trip.
 - 4. Stationary mounting., Drawout construction.
 - 5. Include shunt trip, where indicated.
- K. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and sizes indicated.
- L. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.
- M. Enclosure: Type 1 - General Purpose.
 - 1. Align sections at front and rear.
 - 2. Switchboard Height: 90 inches (2285 mm), excluding floor sills, lifting members and pull boxes.

3. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with a minimum of one coat of corrosion-resistant paint, or plate with cadmium or zinc.

2.3 SOURCE QUALITY CONTROL

- A. Inspect and test each switchboard according to NEMA PB 2.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install switchboards in locations shown on Drawings, according to NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Main circuit breakers shall be solid state type.
- D. Circuit breakers feeding an Automatic Transfer Switch (ATS) shall be coordinated with and in accordance with the With Stand Ratings (WSR) instructions of the ATS.
- E. Distribution circuit breakers shall be molded case type except as noted above.
- F. Field install Arc Flash and Shock Warning labels on each piece of new electrical distribution equipment such as panelboards, safety switches, motor control centers, and automatic transfer switches. The labels will indicate the flash hazard boundry, the flash hazard at 18 inches, the PPE level requirements, and the approach restrictions.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.3 ADJUSTING

- A. Contract Closeout: Testing, Adjusting, and Balancing: Adjusting installed work.
- B. Adjust all operating mechanisms for free mechanical movement.
- C. Tighten bolted bus connections in accordance with manufacturer's instructions.

- D. Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in the circuit.
- E. Determine that each circuit breaker will trip on overcurrent conditions, with tripping times in accordance with NEMA AB 1 requirements..

3.4 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Distribution panelboards
- B. Branch circuit panelboards

1.2 RELATED SECTIONS

- A. Section 260526 - Grounding and Bonding
- B. Section 260553 - Electrical Identification
- C. Section 262813 - Fuses

1.3 REFERENCES

- A. NECA Standard of Installation (published by the National Electrical Contractors Association)
- B. NEMA AB1 - Molded Case Circuit Breakers
- C. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies
- D. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- E. NEMA PB 1 - Panelboards
- F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association)
- H. NFPA 70 - National Electrical Code

1.4 SUBMITTALS FOR REVIEW

- A. Section 260500 - Submittals: Procedures for submittals.
- B. Shop Drawings: Submit scaled drawings 1/2" = 1' showing the physical location of each panelboard in each electrical room in relation to the other panelboards,

switchboards, and mechanical equipment in the room. Indicate panelboard outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 260501 - Submittals: Submittals for information.
- B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout: Submittals for project closeout.
- B. Record actual locations of panelboards and record actual circuiting arrangements in project record documents.
- C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.8 MAINTENANCE MATERIALS

- A. Contract Closeout
- B. Furnish two of each panelboard key.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

- A. Manufacturers: (Any product that meets or exceeds the quality and performance provided by the following manufacturers will be considered.)
 - 1. Square D Co.
 - 2. General Electric
 - 3. Cutler-Hammer

- B. Description: NEMA PB 1, circuit breaker type.
- C. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- D. Integrated Short Circuit Rating:
 - 1. All panelboards, bussing and breakers shall be fully rated to safely interrupt available short circuit currents. The AIC ratings shown on the drawings are the minimum ratings that can be provided.
- E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 rms amperes symmetrical let-through current and energy level less than permitted for same size Class RK-5 fuse. Include shunt trip, where indicated.
- G. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- H. Enclosure:
 - 1. Interior Dry Locations: NEMA 1
 - 2. Exterior and Wet Locations: NEMA 3R or 4X stainless steel where shown on the plans.
- I. Cabinet Front: Flush or Surface type as indicated, fastened with concealed trim clamps, hinged door with flush lock, welded metal directory frame, finished in manufacturer's standard gray enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers: (Any product that meets or exceeds the quality and performance provided by the following manufacturers will be considered.)
 - 1. Square D Co.
 - 2. General Electric
 - 3. Cutler-Hammer
- B. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

- C. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard, provide insulated ground bus where scheduled.
- D. Integrated Short Circuit Rating:
 - 1. All panelboards, bussing and breakers shall be fully rated to safely interrupt the available short circuit currents. The AIC ratings shown on the drawings are the minimum ratings that can be provided.
- E. Molded Case Circuit Breakers: NEMA AB 1, thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
- F. Enclosure:
 - 1. Interior Dry Locations: NEMA 1
 - 2. Exterior, Damp, and Wet Locations: NEMA 4X stainless steel
- G. Cabinet Box: 5.75 inches (150 mm) deep, 20 inches (508 mm) wide.
- H. Cabinet Front: Flush or Surface type, as indicated, cabinet front with concealed trim clamps, concealed hinge, welded metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation".
- B. Install panelboards plumb.
- C. Height: 6 feet (1800 mm) to top of panelboard; install panelboards taller than 6 feet (1800 mm) with bottom no more than 4 inches (100 mm) above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise the directory to reflect any circuiting changes required to balance the phase loads.
- F. Provide engraved plastic nameplates under the provisions of Section 260553.

- G. Field install Arc Flash and Shock Warning labels on each piece of new electrical distribution equipment such as panelboards, safety switches, motor control centers, and automatic transfer switches. The labels will indicate the flash hazard boundry, the flash hazard at 18 inches, the PPE level requirements, and the approach restrictions.
- H. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling, below floor. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Section 260526.
- J. Circuit breakers shall be molded case type unless noted otherwise on the plans.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

3.3 ADJUSTING

- A. Contract Closeout
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 262416

SECTION 262417 - TOLL EQUIPMENT CLEAN POWER PANELBOARD

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- A. The system will serve as a networked SCADA system for controlling the power serving the toll operations equipment via external low voltage inputs, and/or from its internal time-of-day clock. Ensure the panelboard contains fifteen, 120 Volt, 20 Amp, 1 pole, remotely operated molded case circuit breakers to allow control/switching of the branch circuits serving the tolling equipment.
- B. Provide a common manufacturer on all major system components to assure seamless integration.

1.2 REFERENCES

- A. Required UL Listings: UL 489 for Molded Case Circuit Breakers, UL 67 for Panelboards, UL 50 for Boxes and Enclosures, and UL 916 for Energy Management Equipment.
- B. NEMA Compliance: PB-1 for Panelboards
- C. NEC 110-10 Compliance
- D. FCC Approval: All assemblies are to be in compliance with FCC Emissions Standards specified in Part 15 Subpart J for Class A applications.

1.3 SYSTEM START-UP AND TRAINING

- A. Start-Up: After the system has been installed, and the documentation delivered to the Department, secure the services of a factory trained manufacturer's representative for two days to verify correct operation of all system components.
- B. Training: At system start-up, arrange for the factory representative to train the Department's personnel.
- C. Factory Support: Ensure factory fax/telephone support is available free of charge during normal business hours to answer programming and application questions during the warranty period.

1.4 WARRANTY

- A. Manufacturer must warrant per industry standard specified equipment to be free from defects in materials and workmanship for the lesser of one year from the date of installation or eighteen months from date of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The panelboard control system shall be POWERLINK-G3 3000 Level as manufactured by Square D Company. (Due to system compatibility issues this is the only acceptable product)

2.2 PANELBOARD CONTROL SYSTEM

- A. Ensure the NF3000G3 control system consists of a microprocessor-based controller that provides system intelligence for 168 remotely operated branch circuits. Ensure the circuit breakers provide overcurrent protection meeting or exceeding the fault current of the system where the panelboard is being applied.
 - 1. Ensure the control system meets or exceeds the following capabilities:
 - a. Individual remote control for 42 branch circuits.
 - b. Up to sixteen 2-wire maintained dry-contact inputs for connection to external low voltage (24 VDC or below) switch contacts.
 - c. Zone creation of multiple branch circuits and control of individual branch circuits or zones.
 - d. Individual branch circuit and zone override.
 - e. True closed loop control by monitoring branch circuit breaker status based on actual system voltage at load side terminal.
 - f. Downloadable firmware that will permit field installation of newest features in existing systems.
- B. Ensure all control components are installed in a conventional panelboard enclosure. Provide suitable barriers between Class 1 and Class 2 wiring.

2.3 HARDWARE

- A. To minimize installation labor and space requirements, ensure the remote operated circuit breakers, power interface module and control module are integral to the lighting panelboard.
- B. Remote Operated Circuit Breakers

1. Ensure all remote operated branch circuit breakers provides overload and short circuit protection suitable for that location in the electrical system, as defined in the panelboard schedules. Ensure remote operated power switching devices provide the following:
 - a. Load switching endurance rating of 200,000 open/close operations at full load and 0.8 lagging power factor.
 - b. Ensure 15A, 20A, and 30A current ratings are available for remote operated power switching devices. Ensure power switching devices provide integral branch circuit overcurrent protection as required by the National Electrical Code (NEC), and are either fully rated or have published series connected ratings for providing adequate protection at that point in the system.
 - c. Ensure power switching devices are available in single-, two-, and three-pole configurations.
 - d. UL Listing SWD rating on 15A and 20A 1-, 2- and 3-pole branches, UL Listed HACR rating and UL Listed HID rating on all remotely operated power switching devices.
 - e. Handle that mechanically opens power switching device contacts when moved to the OFF position and disables remote control capabilities of the device.
 - f. Ensure operating mode selector button on each power switching device is provided to enable or disable remote operated function of the device independent of the handle.
 - g. Visible flag to clearly indicate the status of the circuit breaker contacts. Ensure status condition includes: ON, OFF, TRIPPED. Ensure the visible flag is mechanical in nature, directly tied to the breaker mechanism, and is provided in addition to any status indicator supplied by the system electronics. Ensure switching devices not equipped with such an indicator is equipped with an alarm and auxiliary contacts.
 - h. Ensure all individual power switching devices rated for 120/240 or 208Y/120 VAC have a short circuit interrupting rating of 14,000 rms symmetrical amperes, minimum.
 - i. Ensure panel is provided with a main circuit breaker and series tested rated and have a short circuit interrupting rating of 42,000 rms symmetrical amperes, minimum.

- j. Ensure power switching devices meet all NEC requirements for circuit breakers; shall be UL Listed as circuit breakers.
- k. Ensure all electronic modules and circuit breakers in the panelboard are mounted in the positions and control the loads as indicated on the panelboard drawings.
- l. Ensure panelboards accept standard circuit breakers for loads not controlled by the system.

C. Interconnections

- 1. Ensure all interconnections between circuit breakers, control buses and power interface modules meet NEC and UL requirements for Class 1 control circuits.
- 2. Use modular control buses to provide control power and communications to the remote operated branch breakers.

D. Power Interface Module

- 1. Provide power interface module to supply 120 VAC control power for the operation of the remotely operated circuit breakers, power for low voltage inputs, and power for the electronics and communications.
- 2. Ensure the module provides screw type terminals for up to sixteen 2-wire maintained or 2-wire momentary inputs, or eight 3-wire momentary inputs for connection to external low voltage (24 VDC or below) switch contacts.

E. Control Module

- 1. Ensure a control module is provided where indicated. Ensure the control module provides time clock, communications, and programming functionality. There are two front panel display options:
 - a. Ensure display control module has high-resolution graphics LCD display and keypad that will permit programming of the system, control override of the breaker status, give electronic indication of the breaker status and display diagnostic information at the front panel.
 - (1) Provide a display control module for each lighting control panelboard.
 - b. Ensure the control module with time-of-day control meets or exceeds the following capabilities:

- (1) Ability to execute up to 4 daily schedules.
- (2) 365-day calendar with automatic leap year correction, and daylight savings time adjustment
- (3) Astronomical clock with sunrise/sunset
- (4) 7-day repeating scheduler
- (5) 12-hour AM/PM or 24-hour military time format
- (6) 32 special holiday/event periods
- (7) Programmable sequence delay of circuit breakers
- (8) Local display of day/date/time (with available LCD display)
- (9) Adjustable timer for inputs (time overrides)
- (10) Priority maintained inputs
- (11) Adjustable flash notice assignable to time-of-day or timed inputs commands
- (12) Capacitor back-up power for time clock back up for 30 days.

2. Ensure the control module has downloadable firmware so that the latest production features may be added in the future without replacing the module.

2.4 NETWORK

- A. Ensure RS-485 network option enables the panelboard control system to connect with other control systems.
 1. User may set-up, monitor and control any panelboard connected to the network from a remote workstation.
 2. Configure network to support all panelboards and personal computer workstations as required.

2.5 SYSTEM SOFTWARE

- A. Ensure the software provides a user-friendly interface for set-up and maintenance of input-based and time-based schedules.
- B. Ensure software provides remote monitoring and control of the system or individual remotely operated circuit breakers.
- C. Operates on a Windows 3.1/Windows 2003 platform.

PART 3 - INSTALLATION

3.1 EQUIPMENT INSTALLATION AND DOCUMENTATION

A. Installation

1. Ensure the panelboard control system with remotely operated circuit breakers is installed and wired completely as shown on the plans by the contractor.
2. Ensure all remote control wiring is installed in accordance with Article 725, Class 2 of the National Electrical Code and local codes.
3. Use wire size as recommended by manufacturer, but must not be smaller than #24 AWG.
4. Install system in accordance with manufacturer's written instructions and the NEC.
5. Coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.

PART 4 - BASIS OF PAYMENT - All of the work of this Section is included in the Lump sum Cost of the Toll Plaza, Item 735-88.

END OF SECTION 26417

SECTION 262713 – ELECTRICITY METERING AND UTILITY SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Service racks
- B. Metering transformer cabinets
- C. Meter bases

1.2 RELATED SECTIONS

- A. Section 262413 - Distribution Switchboards: Metering transformer compartment.

1.3 REFERENCES

- A. NECA Standard of Installation (National Electrical Contractors Association)
- B. NFPA 70 - National Electrical Code

1.4 SYSTEM DESCRIPTION

- A. System Characteristics: 208Y/120 volts, three phase, four- wire, 60 Hertz.

1.5 SUBMITTALS FOR REVIEW

- A. Section 260501 - Submittals: Procedures for submittals.
- B. Product Data: Provide ratings and dimensions of transformer cabinets and meter bases. Include the Utility contact information, the electric meter base configuration and the utility transformer pad details in the engineering submittals.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with Utility Company written requirements.
- B. Maintain one copy of each document on site.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.

- B. Products: Listed and classified by Underwriters Laboratories, Inc. and acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 UTILITY FEES

- A. Contact the Utility Company to determine if fees, charges or costs are required by the Utility Company for permanent power installation. Notify the General Contractor in writing of all costs that are not included in the Electrical Contractors base bid.

1.9 PRE-INSTALLATION MEETING

- A. Coordination and Meetings: Pre-installation meeting.
- B. Convene one week prior to commencing work of this section. Review service entrance requirements and details with Utility Company representative.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Utility Company drawings.

PART 2 - PRODUCTS

2.1 METER BASES

- A. Meter base will be furnished by the Electrical Contractor.

2.2 PAD FOR UTILITY TRANSFORMER

- A. Description: Sized and configured as required by the Utility. Provided and installed by the Electrical Contractor.

2.3 SECONDARY CONNECTION CABINET

- A. If the quantity of underground service entrance conductors is greater than the utility pad mounted transformer lugs can accept, then provide a secondary connection cabinet installed by the Electrical Contractor between the utility transformer and the service entrance point on the building. Ensure the customer's service entrance conductors and the utilities service entrance conductors are properly joined inside this enclosure. Contact the utility company for the specifications and requirements of this cabinet.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Arrange with Utility Company to obtain permanent electric service to the Project. Contact the Utility Company within 10 days of the award of contract and coordinate permanent electric service.

3.2 INSTALLATION

- A. Transformer pad, metering transformer cabinets, and meter base as required by the local Utility Company.

END OF SECTION 262713

SECTION 262716 - ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hinged cover enclosures
- B. Cabinets
- C. Terminal blocks
- D. Accessories

1.2 RELATED SECTIONS

- A. Section 260529 – Hangers and Supports for Electrical Systems

1.3 REFERENCES

- A. Quality Control
- B. NECA Standard of Installation (National Electrical Contractors Association)
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- D. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems
- E. NFPA 70 - National Electrical Code

1.4 SUBMITTALS FOR REVIEW

- A. Section 260500- Submittals: Procedures for submittals.
- B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 260500- Submittals: Submittals for information.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 MAINTENANCE MATERIALS

- A. Contract Closeout
- B. Furnish two of each key.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)

- A. Hoffman
- B. Wiegmann.

2.2 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, Type 1 or 4X steel enclosure as required for the application or shown on the plans.
- B. Covers: Continuous hinge, held closed by flush latch operable by key.
- C. Provide interior metal panel with stand off brackets for mounting terminal blocks and electrical components; finish with white enamel.
- D. Enclosure Finish: Manufacturer's standard enamel or brushed stainless steel.
- E. Provide metal barriers to form separate compartments wiring of different systems and voltages.

2.3 CABINETS

- A. Boxes: Galvanized steel
- B. Box Size: 24-inches (600-mm) wide x 24 inches (600 mm) high x 6-inches (150-mm) deep, minimum, increase dimensions as required for application.
- C. Provide interior metal panel with stand off brackets for mounting terminal blocks and electrical components; finish with white enamel.
- D. Fronts: Steel, flush or surface as indicated with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- E. Knockouts: None

- F. Provide metal barriers to form separate compartments wiring of different systems and voltages.
- G. Provide mounting rack for free-standing equipment.

2.4 TERMINAL BLOCKS

- A. Terminal Blocks: NEMA ICS 4
- B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- D. Provide ground bus terminal block, with each connector bonded to enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation".
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner under the provisions of Section 260529.
- C. Install cabinet fronts plumb.
- D. All cabinets and enclosures shall be hinged cover enclosures as noted in 2.2 above except the following locations shall be cabinet type as noted in 2.3 above:
 - 1. Electrical Rooms
 - 2. Mechanical Rooms
 - 3. Systems Rooms
 - 4. Above accessible ceilings (only when indicated on the drawings)
 - 5. Flush wall applications where indicated on the drawings.
 - 6. Cabinet type enclosures shall not be acceptable in exterior or wet locations.

3.2 CLEANING

- A. Clean electrical parts to remove conductive and harmful materials.
- B. Remove dirt and debris from enclosure.
- C. Clean finishes and touch up damage.

END OF SECTION 262716

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall switches
- B. Receptacles
- C. Device plates and box covers
- D. Floor box service fittings

1.2 RELATED SECTIONS

- A. Section 260533 – Raceways and Boxes for Electrical Systems

1.3 REFERENCES

- A. NECA - Standard of Installation
- B. NEMA WD 1 - General Requirements for Wiring Devices
- C. NEMA WD 6 - Wiring Device -- Dimensional Requirements
- D. NFPA 70 - National Electrical Code

1.4 SUBMITTALS FOR REVIEW

- A. Section 260500 - Submittals: Procedures for submittals.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations and ratings.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 260500 - Submittals: Submittals for information.
- B. Submit manufacturer's installation instructions.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)
 - 1. Pass & Seymour
 - 2. Hubbell
- B. Description: NEMA WD 1, commercial specification grade, AC only general-use snap switch.
- C. Configuration and Model:
 - 1. Single pole toggle light switch, P & S 20AC1.
 - 2. Provide same series switch for other configurations.
- D. Ratings:
 - 1. Voltage: 120-277 volts, AC
 - 2. Current: The minimum rating shall be 20 amp unless indicated higher on plans. Increase rating if load served exceeds rating scheduled, (rating shall exceed load served).
- E. All wiring devices shall be provided grounding screw and terminal.

2.2 RECEPTACLES

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)
 - 1. P & S
 - 2. Hubbel
- B. Description: NEMA WD 1, commercial specification grade general use receptacle.
- C. Configuration and Model:
 - 1. Single and Duplex Receptacles - 2 pole, 3 wire grounding type, back and side wired, 20 amp, 125 volt, P & S CR20.
 - 2. Ground fault interrupting receptacles shall be duplex feed through type with test and reset buttons, P & S 2094.

- D. Voltage rating: Match branch circuit voltage.
- E. Current rating: The minimum rating shall be as indicated in schedule. Increase rating if the load served exceeds the rating scheduled, (rating shall exceed load served).
- F. All wiring devices shall be provided with a grounding screw and terminal.

2.3 WALL PLATES

- A. Cover Plates: Smooth thermoset plastic plates.
- B. Weatherproof Cover Plate: Cast zinc cover plate with a “While-In-Use” cast zinc hinged weather proof and padlockable door. Pass & Seymour #WIUC10CABRV.

2.4 WIRING DEVICE COLOR

- A. Device color shall be ivory, unless noted otherwise or for special purpose outlets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Coordination and Meetings
- B. Verify that outlet boxes are installed at proper height. Coordinate outlet heights with architectural elevations and millwork shop drawing.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that floor boxes are adjusted properly.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that openings in access floor are in proper locations.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation".
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- E. Do not share neutral conductor on load side of dimmers.
- F. Install receptacles with the grounding pole on the bottom.
- G. Connect wiring device grounding terminal to outlet box and branch circuit equipment grounding conductor.
- H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- I. Connect wiring devices by wrapping the solid conductor around the screw terminal and tightening the screw snugly. Back wiring/back stabbing is not acceptable. Stranded conductors shall be terminated with compression style lugs.
- J. Install cast iron plates on outlet boxes and junction boxes in unfinished areas and on surface mounted outlets.
- K. Install wiring devices as indicated on the Drawings, and as called for below.
- L. Switches and receptacles shall be installed and located as follows, unless noted otherwise on Drawings.
 - 1. Switches: Centerline 46" above finished floors.
 - 2. Receptacles: Centerline 18" above finished floors generally; 8" above counters and workbenches in kitchens, shops, mechanical rooms and similar areas. Verify and coordinate exact height and locations with Architectural plans and elevations and millwork shop drawings.
- M. Where light switches are located adjacent to doors, they shall be installed on "knob" side of door. Field-verify door swings.
- N. Where walls have wainscot finish, switch height shall be adjusted as required, so switch is either all in wainscot or all in wall above wainscot. Switch centerline shall be no higher than 46" AFF.
- O. Prior to roughing-in outlet boxes, Verify from general construction drawings; door swings, type of wall finishes and locations for counters and other equipment.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 260533 to obtain mounting heights indicated on drawings.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.
- F. Verify that each telephone jack is properly connected and circuit is operational.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fuses
- B. Spare fuse cabinet

1.2 REFERENCES

- A. NFPA 70 - National Electric Code
- B. NEMA FU 1 - Low Voltage Cartridge Fuses

1.3 SUBMITTALS

- A. Submit under provisions of Section 260501.
- B. Product Data: Provide data sheets showing electrical characteristics including time-current curves.

1.4 PROJECT RECORD DOCUMENTS

- A. Record actual fuse sizes and catalog numbers. Include this information in the O&M Manuals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.

1.6 MAINTENANCE MATERIALS

- A. Provide one set of spare fuses for each fuse size and type used on the project.
- B. Provide two fuse pullers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)

- A. Bussmann
- B. Ferraz Shawmut

- C. Little Fuse

2.2 FUSE REQUIREMENTS

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. Main Service Switches Larger than 600 amperes: Class L (time delay).
- D. Main Service Switches: Class RK1 (time delay).
- E. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).
- F. Power Load Feeder Switches: Class RK1 (time delay).
- G. Motor Load Feeder Switches: Class RK1 (time delay).
- H. Lighting Load Feeder Switches: Class RK1 (non-time delay).
- I. Power Branch Circuits: Class RK1 (time delay).
- J. Motor Branch Circuits: Class RK1 (time delay).

2.3 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified. Provide two sets of each fuse type or style.
- B. Doors: Hinged, with hasp for Department's padlock.
- C. Finish: Gray Enamel

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in accordance with manufacturer's instructions.
- B. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet in the main electric room.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Enclosed circuit breakers.

1.2 RELATED WORK

- A. Section 260529 – Hangers and Supports for Electrical Systems
- B. Section 260553 - Identification for Electrical Systems

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NEMA AB 1 - Molded Case Circuit Breakers
- C. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 260500.
- B. Product Data: Provide catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Any product that meets or exceeds the quality and performance of the following manufacturers will be considered)

- A. Square D Company
- B. General Electric
- C. Cutler Hamer

2.2 CIRCUIT BREAKER

- A. Molded Case Circuit Breakers: NEMA AB 1, integral thermal and instantaneous magnetic trip in each pole.
 - 1. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
 - 2. Include shunt trip, where indicated.
- B. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 rms amperes symmetrical let-through current and energy level less than permitted for same size Class RK-5 fuse. Include shunt trip, where indicated.
- C. Solid-state Molded Case Circuit Breakers: NEMA AB 1, with electronic sensing, timing and tripping circuits for adjustable current settings.
 - 1. Ground fault trip, ground fault sensing integral with circuit breaker.
 - 2. Instantaneous trip.
 - 3. Adjustable short time trip.
 - 4. Stationary mounting., Drawout construction.
 - 5. Include shunt trip, where indicated.

2.3 PRODUCT OPTIONS AND FEATURES

- A. Provide accessories as scheduled, to NEMA AB 1.
- B. Handle Lock: Include provisions for padlocking.
- C. Provide mechanical trip device.
- D. Provide factory type grounding lug in each breaker enclosure.
- E. Provide Products suitable for use as service entrance equipment where so applied.

2.4 ENCLOSURE

- A. Enclosure: NEMA AB 1
 - 1. Interior Dry Locations: NEMA 1
 - 2. Exterior and Wet Locations: NEMA 3R or 4X stainless steel where shown on the plans.

- B. Finish using manufacturer's standard enamel finish, gray color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 260529.
- C. Height: 5 ft (1.6 M) to operating handle.
- D. Provide engraved plastic nameplates under the provisions of Section 260553.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test each circuit breaker to NEMA AB 1.
- B. Inspect each circuit breaker visually.
- C. Perform several mechanical ON-OFF operations on each circuit breaker.
- D. Verify circuit continuity on each pole in closed position.
- E. Determine that circuit breaker will trip on overcurrent conditions, with tripping times in accordance with NEMA AB 1 requirements.
- F. Include description of testing and results in test report.

3.3 ADJUSTING

- A. Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in circuit.
- B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION 262816

SECTION 262817 - ENCLOSED SAFETY SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches
- B. Nonfusible switches

1.2 RELATED SECTIONS

- A. Section 262813 - Fuses

1.3 REFERENCES

- A. NECA - Standard of Installation (published by the National Electrical Contractors Association)
- B. NEMA FU1 - Low Voltage Cartridge Fuses
- C. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (published by the International Electrical Testing Association)
- E. NFPA 70 - National Electrical Code

1.4 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals.
- B. Product Data: Provide switch ratings and enclosure dimensions.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout
- B. Record actual locations of enclosed switches in project record documents.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)

- A. Square D Co.
- B. General Electric
- C. Cutler-Hammer

2.2 FUSIBLE SWITCH ASSEMBLIES

- A. Description: UL 98 and NEMA KS 1, heavy duty type, with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position. Install the factory provided equipment grounding bar in each switch. Fastening the grounding conductors to the inside of the painted enclosure with a screw is not acceptable.
- B. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.

2.3 NONFUSIBLE SWITCH ASSEMBLIES

- A. Description: UL 98 and NEMA KS 1, heavy duty type, with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position. Install the factory provided equipment grounding bar in each switch. Fastening the grounding conductors to the inside of the painted enclosure with a screw is not acceptable.

2.4 ENCLOSURES

- A. Fabrication: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1
 - 2. Exterior Damp and Wet Locations: NEMA 3R. or 4X (stainless steel) when shown on the plans.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation".
- B. Install fuses in fusible disconnect switches.

- C. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION 262817

SECTION 262913 - ENCLOSED MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual motor starters
- B. Magnetic motor starters
- C. Combination magnetic motor starters

1.2 RELATED SECTIONS

- A. Section 260529 – Hangers and Support for Electrical Systems
- B. Section 260553 – Identification for Electrical Systems
- C. Engraved nameplates.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code
- B. NECA "Standard of Installation," published by National Electrical Contractors Association
- C. NEMA AB 1 - Molded Case Circuit Breakers
- D. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies
- E. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- F. NEMA KS 1 - Enclosed Switches

1.4 SUBMITTALS

- A. Submit under provisions of Section 260501.
- B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Test Reports: Indicate field test and inspection procedures and test results.

- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.7 EXTRA MATERIALS

- A. Provide three spare fuses for each size and type installed on the job.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Products that meet or exceed the performance and quality of the following manufacturers will be considered.)

- A. Square D Company
- B. General Electric
- C. Cutler-Hammer

2.2 MANUAL CONTROLLERS

- A. Manual Motor Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller with overload element, red pilot light, NO and NC auxiliary contact, and push button operator.
- B. Fractional Horsepower Manual Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.
- C. Motor Starting Switch: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with toggle operator.
- D. Enclosure: NEMA ICS 6; Type 1 or 4 as required for the application.

2.3 AUTOMATIC CONTROLLERS

- A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Reversing Controllers: Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.
- C. Two Speed Controllers: Include integral time delay transition between FAST and SLOW speeds.
- D. Coil operating voltage: Match control voltage.
- E. Overload Relay: NEMA ICS; [bimetal] [melting alloy.]
- F. Enclosure: NEMA ICS 6, Type 1 or as required for application.

2.4 PRODUCT OPTIONS AND FEATURES

- A. Auxiliary Contacts: NEMA ICS 2, 2 each normally open and closed contacts in addition to seal-in contact.
- B. Cover Mounted Pilot Devices: NEMA ICS 2, heavy duty oil tight type.
- C. Pilot Device Contacts: NEMA ICS 2, Form Z, rated A150.
- D. Pushbuttons: Shrouded type.
- E. Indicating Lights: Transformer LED type.
- F. Selector Switches: Rotary type.
- G. Relays: NEMA ICS 2
- H. Control Power Transformers: Provide fused primary and secondary, and bond the unfused grounded leg of the secondary to the enclosure. Match control voltage.

2.5 DISCONNECTS

- A. Combination Controllers: Combine motor controllers with motor circuit protector disconnect in common enclosure.
- B. Motor Circuit Protector: NEMA AB 1, circuit breakers with integral instantaneous magnetic trip in each pole.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed controllers plumb. Provide supports in accordance with Section 260529.
- C. Height: 5 ft (1.6 M) to operating handle.
- D. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- E. Provide engraved plastic nameplates under the provisions of Section 260553.
- F. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test each enclosed controller to NEMA ICS 2.

END OF SECTION 262913

SECTION 262914 - ENCLOSED CONTACTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General purpose contactors
- B. Lighting contactors

1.2 REFERENCES

- A. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies
- C. NFPA 70 - National Electrical Code

1.3 SUBMITTALS FOR REVIEW

- A. Section 260501 - Submittals: Procedures for submittals.
- B. Product Data: Provide dimensions, size, voltage ratings and current ratings.

1.4 SUBMITTALS FOR INFORMATION

- A. Submittals: Submittals for information.
- B. Submit manufacturer's installation instructions.

1.5 PROJECT CLOSEOUT SUBMITTALS

- A. Contract Closeout: Submittals for project closeout.
- B. Record actual locations of each contactor and indicate circuits controlled on project record documents.
- C. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)

1. Square D Co.
2. General Electric
3. Substitutions: Not permitted.

B. Description: NEMA ICS 2, AC general purpose magnetic contactor.

C. Size: As indicated.

D. Enclosure: ANSI/NEMA ICS 6, Type 1 or 3R or 4 as required to meet conditions of installation.

E. Accessories:

1. Pushbutton: ON/OFF
2. Selector Switch: ON/OFF, ON/OFF/AUTOMATIC
3. Indicating Light: RED, GREEN
4. Auxiliary Contacts: One, normally open, normally closed, field convertible.

2.2 LIGHTING CONTACTORS

A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)

1. Square D Co.
2. General Electric
3. Cutler-Hammer

B. Description: NEMA ICS 2, magnetic lighting contactor.

C. Configuration: Mechanically held, 3 wire control.

E. Coil Voltage: 120 volts, 60 Hertz.

F. Poles: As indicated.

G. Contact Rating: 30 amperes.

H. Enclosure: ANSI/NEMA ICS 6, Type 1 or 4X as required to meet conditions of installation.

I. Accessories:

1. Selector Switch: ON/OFF, ON/OFF/AUTOMATIC
2. Indicating Light: RED, GREEN
3. Auxiliary Contacts: One, normally open, normally closed, field convertible.

2.3 ACCESSORIES

- A. Pushbuttons and Selector Switches: NEMA ICS 2, heavy duty type.
- B. Indicating Lights: NEMA ICS 2, transformer type.
- C. Auxiliary Contacts: NEMA ICS 2, Class A300

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install contactors where indicated, in accordance with manufacturer's instructions.
- B. Install contactors plumb. Provide supports in accordance with Section 260529.
- C. Height: 5 ft to center.
- D. Provide engraved plastic nameplates under the provisions of Section 260553.

END OF SECTION 262914

SECTION 262924 – ELEVATOR RECALL CONTROL AND SUPERVISORY UNIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire alarm control panels for use as elevator recall control and supervisory control unit
- B. Fire alarm initiating devices
- C. Fire alarm notification appliances
- D. Auxiliary fire alarm equipment

1.2 RELATED SECTIONS

- A. Hydraulic Elevators
- B. Section 260519 – Low Voltage Electrical Power Conductors and Cables

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code
- B. NFPA 72 - National Fire Alarm Code
- C. NFPA 101 - Life Safety Code
- D. Florida Building Code
- E. Florida Fire Protection Code
- F. ANSI/ASME A17.1a

1.4 SYSTEM DESCRIPTION

- A. Elevator Control System: NFPA 72, ANSI/ASME A17.1b, noncoded, addressable, automatic local elevator recall control and supervisory control system with internet monitoring accessory to monitor alarms remotely from the Sun Watch control center in Orlando, FL.

1.5 SUBMITTALS

- A. Shop Drawings: Provide annunciator layout and system wiring diagram showing each device and wiring connection required.
- B. Product Data: Provide electrical characteristics, battery calculations and connection requirements.
- C. Test Reports: Indicate satisfactory completion of required tests and inspections.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

1.6 PROJECT RECORD DOCUMENTS

- A. Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

1.7 OPERATION AND MAINTENANCE DATA

- A. Operation Data: Operating instructions.
- B. Maintenance Data: Maintenance and repair procedures.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in installing the products specified in this section with minimum three years experience, and certified by State of Florida as fire alarm installer.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/ASME A17.1a, NFPA 70, and NFPA 101.
- B. Furnish products listed and classified by UL FM and acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of fire alarm system for one year from Date of Substantial Completion.

1.11 EXTRA MATERIALS

- A. Provide six keys of each type.
- B. Provide three of each type of automatic smoke detector without base.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)

- A. EST
- B. Notifier
- C. Simplex

2.2 ELEVATOR RECALL CONTROL AND SUPERVISORY CONTROL UNIT (ERU)

- A. Control Panel: Modular construction with flush, surface wall-mounted enclosure.
- B. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, relays, and alarm signaling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 5 minutes.
- C. System Supervision: Component or power supply failure places system in trouble mode.
- D. Signaling Line Circuits: Supervised module with alarm and trouble indication; occurrence of single ground or open condition places circuit in trouble mode but does not disable that circuit from initiating an alarm.
- E. Remote Station Signal Transmitter: Electrically supervised digital alarm communicator transmitter, capable of transmitting alarm and trouble signals over the internet to the FTE Sun Watch control center in Orlando, FL.
- F. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.
- G. Provide Trouble Acknowledge, Drill, and Alarm Silence switch.
- H. Trouble Sequence of Operation: System or circuit trouble places system in trouble mode, which causes the following system operations:

1. Trouble signal transmitted to central station.
 2. Manual acknowledge function at fire alarm control panel silences audible trouble alarm; visual alarm is displayed until initiating failure or circuit trouble is cleared.
- I. Alarm Sequence of Operation: Actuation of initiating device places circuit in alarm mode, which causes the following system operations:
1. Transmit non-coded signal to Sun Watch control center.
 2. Indicate the location of the alarm device on the elevator recall and supervisory control panel (ERU).
 3. Transmit signals to building elevator control panel to initiate Phase 1 Recall to the main floor or alternate floor. If the alarming device is on the main floor, then the elevator shall return to the lower floor. If the alarm device is on the lower floor then the elevator shall return to the main floor.
- J. Alarm Reset: System remains in alarm mode until manually reset with key-accessible reset function; system resets only if initiating circuits are out of alarm mode.
- K. Lamp Test: Manual lamp test function causes alarm indication at each zone at fire alarm control panel and at annunciator panel.
- L. Drill Sequence of Operation: Manual drill function causes alarm mode operation as described above.
- M. Zoning: Addressable

2.3 INITIATING DEVICES

- A. Ceiling Mounted Smoke Detector: NFPA 72, addressable photoelectric type with adjustable sensitivity, plug-in base, auxiliary relay contact, integral thermal element rated 135° F (57°C), and visual indication of detector actuation, suitable for mounting on 4 inch (102 mm) outlet box.

2.4 AUXILIARY DEVICES

- A. Addressable Interface Device: Microelectronic monitor module with integral relay to initiate elevator recall and power shut down.
- B. Control Relays: UL listed SPDT or DPDT 10 amp rated contacts, status LED. Provide metal enclosure w/LED Viewing Port.

2.5 WIRE AND CABLE

- A. Power Branch Circuits: EMT conduit and THHN copper wire.

- B. Initiating Device and Indicating Appliance Circuits: Non-power limited fire-protective signaling cable, copper conductor, 150 volt insulation rated 60°C. Power limited fire-protective signaling cable, copper conductor, 300 volts insulation rated 105 degrees C.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install the elevator lobby smoke detectors on the lobby ceiling within 10 ft of the center line of the elevator door. Do not install smoke detectors within 36 inches of an HVAC air supply or return register.
- C. Install the elevator machine room smoke detector on the ceiling within 10 ft of the center of the room. Do not install smoke detectors within 36 inches of an HVAC air supply or return register.
- D. Install the ERU control panel on the ground level near the main entry door to the building. Provide and install a 120 Volt, 20 Amp, 12 AWG branch circuit from a local panelboard. Provide a breaker lock-on device for the circuit breaker.
- E. Use 16 AWG minimum size conductors for fire alarm detection and signal circuit conductors. Install wiring in conduit.
- F. Mount end-of-line device with the last device or in a separate box adjacent to last device in the circuit.
- G. Make conduit and wiring connections to the smoke detectors, ERU control panel and the elevator controller for Phase 1 Emergency Recall Operation in accordance with Section 2.27 of ASME A17.1, Safety Code For Elevators.
- H. Automatic Detector Installation: Conform to NFPA 72.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under supervision of a Department representative..
- B. Test in accordance with NFPA 72 and any local fire marshal requirements. Complete the attached Test Form from NFPA 72 and leave a copy with the Toll Plaza Manager.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

3.4 CABLE COLOR CODE

- A. Provide circuit conductors with insulation color coded as follows, or using colored tape at each conductor termination and in each junction box.
- B. Power Branch Circuit Conductors: Black, red, white
- C. Initiating Device Circuit: Black, red
- D. Detector Power Supply: Violet, brown
- E. Signal Device Circuit: Blue (positive), white (negative)

3.5 DEMONSTRATION

- A. Provide a systems demonstration to for the Toll Plaza Manager. Verify any local alarms are transmitted to and received by the Sun Watch Control Center in Orlando, FL.
- B. Demonstrate normal and abnormal modes of operation, and required responses to each.

3.6 WARRANTY

- A. Provide an industry standard two year materials warranty that is transferable to the Department and a warranty statement that lists Florida's Turnpike Enterprise as the owner.

END OF SECTION 262924

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Packaged engine generator set
- B. Exhaust silencer, elbows, rain cap and fittings
- C. Fuel fittings and day tank, day tank vent pipe and vent cap.
- D. Remote annunciator panel(s)
- E. Batteries and battery charger
- F. Fuel for load bank testing and fuel to top off tank at final completion.
- G. Vibration isolators under engine generator skids.
- H. Weather protective enclosure

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED IN THIS SECTION

- A. Day tank – if shown on the electrical plans. Installed by Mechanical Contractor.
- B. Exhaust silencer, and fittings.
- C. Insualtion of the silencer and exhaust piping inside the engine room.
Provided/Installed/Applied by the Mechanical Contractor.

1.3 RELATED SECTIONS

- 1. Piping Insulation
- 2. Fuel Oil Piping System
- 3. Hydronic Piping
- 4. Ductwork/Louvers
- 5. Section 263623 - Automatic Transfer Switch

1.4 REFERENCES

- A. NEMA AB1 - Molded Case Circuit Breakers

- B. NEMA MG1 - Motors and Generators
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- D. NFPA 30 - Flammable and Combustible Liquids Code
- E. NFPA 70 - National Electrical Code
- G. NFPA 101 - Life Safety Code
- H. NFPA 110 - Emergency and Standby Power Systems

1.5 SUBMITTALS

- A. Submit under provisions of Section 260501.
- B. Shop Drawings: Provide a complete printout from the manufacturer's sizing program that shows the site environmental conditions, the electrical loads, load steps, instantaneous voltage and frequency dips, and the recommended alternator and engine size. Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams. Provide a site specific, point to point interconnection diagram on 11 x 17 inch paper. The site specific drawing shall show the connection points for the remote annunciator, EPO station, battery charger alarms, day tank alarms, main fuel tank alarms, ATS control wiring, engine start wiring, etc.. Submittals will not be reviewed without this site specific diagram.
- C. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, remote annunciator, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, or skid base tank, outdoor enclosure, and remote radiator.
- D. Test Reports: Indicate results of performance testing.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
- F. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

- G. Manufacturer's Field Reports: Submit under provisions of Section 260500.
- H. Warranty information – Provide a 2 year manufacturers comprehensive warranty on all the items provided under this Engine Generators section and the Automatic Transfer Switch section of the specifications. Clearly indicate the site specific bill of materials covered by the warranty. i.e. Generator enclosure, silencer, battery charger, day tank, etc.. Regular and scheduled maintenance will be performed by a maintenance contractor selected by the Department. Maintenance work by the maintenance contractor shall not void the warranty of the equipment. Requirements for consumables such as oil and filters to be original equipment manufacturer brands are not acceptable and shall not void the warranty of the equipment.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 260507.
- B. Operation Data: Include instructions for normal operation.
- C. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, or skid base tank oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.7 QUALITY ASSURANCE

- A. The engine generator must be a standard product of the manufacturer. The vendor that provides the engine generator package must be a manufacturer's representative for the brand of engine generator that is provided.
- B. Maintain one copy of parts manual and warranty document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years experience, and with service and parts stocking facilities within 100 miles of Project.
- B. Supplier: The supplier/vendor shall be an Authorized Distributor of the products sold. The supplier/vendor shall be factory authorized to supply parts, perform field services, and perform factory warranty work on the products sold. The supplier/vendor shall maintain a parts inventory for the equipment provided and stock 50% of all parts for the engine, generator, and automatic transfer switch at their service facility within 100 miles of the project job site. The Department may inspect the service facility to verify the parts stock.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, NFPA 110, and NFPA 101.
- B. Furnish an engine generator that is EPA Certified to the proper Tier level according to the horse power and end use location.

1.10 PRE-INSTALLATION CONFERENCE

- A. The equipment vendor start-up technician, the E.C. and G.C shall attend a coordination meeting one week prior to commencing work of this Section. Crane requirements, spreader bars, concrete pad requirements, etc. shall be discussed.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protects delivered to the site.
- B. Accept unit on site on skids. Inspect for damages immediately.
- C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.12 MAINTENANCE SERVICES

- A. Furnish the service and maintenance of the engine generator for 12 months from the Date of Substantial Completion at no cost to the Department.
- B. After the EPSS has been installed for 11 months, schedule with the Department, and perform the factory recommended annual engine generator maintenance. As a minimum, this shall include an oil change (with an S.O.S. oil analysis included), an air filter change, fuel filter change, and water separator filter change. Also as a minimum, check and adjust the magnetic pick-up device, the engine valve lash, the injector timing, and the rotators.

After maintenance is complete, perform a one hour long building load test with the available building load. Forward one copy of the maintenance work order to the Department.

There be no cost to the Department for the 11th month maintenance work.

1.13 MAINTENANCE MATERIALS

- A. Provide one set of air filters, oil filters, fuel filters, water separator filters, and fan belts to the Department for future use – to be used after the one year maintenance included period elapses.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS (Any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)

- A. Caterpillar
- B. Cummins
- C. Kohler
- D. Detroit Diesel

2.2 PACKAGE ENGINE GENERATOR SYSTEM

- A. Description: The Emergency Power Supply System (EPSS) shall be classified in accordance with NFPA 110 as Level 2, Type 10, Class 72. Show the classification on the engineering plans.
- B. System Capacity: xxx kW, xxx kVA at elevation of 100 feet above sea level, standby rating using engine-mounted radiator. Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year. Standby power in accordance with ISO8528. Standby ambient temperatures shown indicate ambient temperature at 100% of rated load.
- C. Generator Output Voltage Dip and Frequency Dip: Upon application of rated (full) load, in a single step, the instantaneous voltage dip will not exceed 20% and the instantaneous frequency dip will not exceed 20%.

2.3 ENGINE

- A. Type: Water-cooled inline or V-type, four stroke cycle, compression ignition diesel internal combustion engine.
- B. Fuel System: No. 2 fuel oil.
- C. Engine speed: 1800 rpm.
- D. Governor: Electronic isochronous governor. Random Frequency Variation shall not exceed $\pm 0.25\%$.
- E. Safety Devices: Pre-alarms and Engine shutdowns with alarms for high engine temperature, low oil pressure, overspeed, and emergency stop. Limits as selected by the manufacturer. Also provide overcrank / failure to start lock out and alarm.
- F. Engine Starting: Positive engagement, cycle crank type, DC starting system with the number of starter motors in accordance with manufacturer's instructions. Include remote "two wire" starting controls.
- G. Engine Jacket Coolant Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F (32 degrees C) under all site conditions, and suitable for operation on 208 volts

AC. Also provide isolation valves on the coolant supply and return hoses to facilitate maintenance on the heater.

- I. Radiator: High ambient radiator using propylene glycol based coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F (43 degrees C). Radiator air flow restriction 0.5 inches of water (1.25 Pa) maximum. Provide a metal radiator guard and provide an accessible coolant drain valve on the bottom of the radiator. If the weather protective enclosure makes the drain valve not accessible, then extend a permanent drain hose from the drain valve to the outside of the enclosure.
- J. Engine Accessories: Aftercooler, intake air filter(s) with differential pressure service indicators, spin on lube oil filters, lube oil cooler, gear-driven water pump and crank case fumes disposal tube(s) routed outside. Also provide an oil drain valve on the bottom of the engine oil pan. If the weather protective enclosure makes the drain valve not accessible, then extend a permanent drain hose from the drain valve to the outside of the enclosure.
- K. Engine Fuel System: Primary spin on fuel filter(s) with separate fuel/water separator with metal housing and see through containmentment bowl, fuel transfer pump with a suction head of 9 feet minimum, a hand operated fuel priming pump with an analog fuel pressure gauge mounted next to the hand prime pump. A factory installed fuel oil cooler shall be mounted on the radiator to keep the return fuel temperature below 85 degrees F.
- J. Mounting: Provide unit with suitable spring-type vibration isolators mounted under the structural steel base. If the engine and the alternator are isolated from the structural steel base by rubber snubbers/mounts, then vibration pads may be utilized under the structural steel base.

2.4 GENERATOR

- A. Generator: NEMA MG1, three phase, four pole, 12 lead reconnectible, brushless synchronous generator with brushless permanent magnet exciter.
- B. Rating: xxx kW, xxx kVA, at 0.8 power factor, xxx volts, 60 Hz at 1800 rpm.
- C. Insulation Class: F.
- D. Temperature Rise: 130 degrees C, Standby.
- E. Enclosure: NEMA MG1, drip proof, IP 22 guarded.
- F. Voltage Regulation: Include generator-mounted volts per hertz exciter-regulator to match engine and generator characteristics, with voltage regulation plus or

minus 1 percent from no load to full load. Include manual controls to adjust voltage drop, voltage level (plus or minus 5 percent) and voltage gain.

2.5 ACCESSORIES

- A. Day Tank: UL 142 Listed, xxx gallon, double wall day tank unit with integral duplex 2 GPM fuel pumps, and automatic level controls. Alarms for high level, low level, and over flow. Accessories shall include: Auxiliary hand pump 5 GPM, locking manual fill cap, vent cap with insect screen, manual fuel cutoff ball valve, fuel flow indicator sight glass, DC solenoid valves on each electric pump intake, drain hand ball valve, over flow basin hand drain ball valve, foot valve to prevent loss of prime for the engine fuel pump, and a system circuit breaker as a local disconnecting means.
- B. Exhaust Silencer: Critical type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting assembly, sized in accordance with engine manufacturer's instructions. Also provide an outlet elbow and a rain cap. If the exhaust piping penetrates the top of the outdoor enclosure, a rain collar shall be installed around the exhaust piping to minimize water entering the weather proof enclosure.
- D. Batteries: Heavy duty, diesel starting type lead-acid storage batteries. The advertised Cold Cranking Amps shall be at 0 °F. Match the battery voltage to the engine starting system. Include copper battery cables and a key operated battery disconnect switch. Submit data sheet to the engineer on the battery switch.
- D. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.
- E. Battery Charger: Magnetic amplifier design, 10 Amps DC output with current limiting at 140%. Automatic float/equalize mode designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell, and rated for use at ambient temperatures up to 120 °F. Accessories shall include: Analog DC Voltmeter and Ammeter, alarms for low DC volts, high DC volts, and charger failure. Provide a wall-mounted enclosure to meet NEMA 250, Type 1 requirements. The manufacturer shall provide a 10 year standard warranty on the charger.
- F. Line Circuit Breaker: NEMA AB 1, molded case circuit breaker, generator mounted in a NEMA 1 enclosure. The circuit breaker enclosure shall provide adequate space for the Electrical Contractor to bend the generator feeder conductors in accordance with the NEC. The circuit breaker protective trip unit shall include integral thermal and instantaneous magnetic trips in each pole, sized in accordance with NFPA 70. Include a battery-voltage operated shunt trip accessory, connected to open the circuit breaker when the engine shuts down due to any protective shutdown from the engine generator control panel. The circuit breaker shall not trip open during a normal generator shutdown.

G. Engine-Generator Control Panel: NEMA 1, IP22 generator mounted control panel made of heavy duty sheet steel and vibration isolated from the engine generator set. The control panel shall house the engine and generator controls, gauges and indicators. Also provide a hinged vandal door over the face of the control panel with provisions for a padlock. The control panel shall include the following equipment and features:

1. Frequency Meter: 45-65 Hz. range
2. AC Output Voltmeter with true RMS sensing, 1/2 percent accuracy with phase selector switch.
3. AC Output Ammeter with true RMS sensing, 1/2 percent accuracy with phase selector switch.
4. Output voltage adjustment.
5. Push-to-test indicator lamps, for low oil pressure, high water temperature, overspeed, and overcrank shutdowns.
6. Engine Off/Auto/Start/Stop selector switch.
7. Engine running time meter.
8. Oil pressure gauge.
9. Fuel pressure gauge
10. Water temperature gauge.
11. Emergency stop button
10. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
11. Additional visual indicators and alarms as required by the Safety Indication and Shutdown table below.
12. Remote Alarm Contacts: Pre-wire SPDT contacts to a terminal strip for remote alarm functions required by NFPA 110.
13. Provide over voltage protection (ANSI #59) and under voltage protection (ANSI #27) to protect the generator and/or building distribution system from a voltage regulator malfunction. Over voltage relay settings shall be adjustable from 100% - 125% of nominal voltage. Under voltage relay settings shall be adjustable from 75% - 100% of nominal voltage. When the generator set is producing power, an over voltage or under voltage condition shall cause the main generator breaker to trip open and the engine emergency stopped. The engine shall not attempt to restart until the fault is acknowledged and the fault reset button is depressed. The main generator breaker shunt trip accessory shall be operated by the engine starting batteries. When the engine generator shuts down normally and stops producing power, this shall not be considered a fault and the under voltage relay shall not cause the generator main breaker to trip open and emergency stop the engine.
14. The generator control panel shall include a Modbus TCP/IP communication port for connection to FTE SCADA system. Install a spare 3/4 inch conduit for this purpose between the SCADA control panel and the generator control panel.

- H. Remote Annunciator Panel: Flush mounted panel with brushed stainless steel face. The alarm and indicating lamps shall be LED lamps. The alarm horn shall sound at 50 dB. Ship the back box to the E.C. early to facilitate installation in the building during construction. Provide audible and visible indicators and alarms required by the Safety indication and Shutdown table below..

1.Safety Indication and Shutdowns

b)Indicator Function	2.Level 1			B	C.Level 2		
	C.V.	D.S	R.A.		C.V.	E.S	F.R. A.
Overcrank	x	x	x		x	x	o
1.Low water temp 70 degrees F	x		x		x		o
High engine temperature prealarm	x		x		o		
High engine temperature	x	x	x		x	x	o
Low lube oil pressure prealarm	x		x		o		
Low lube oil pressure shutdown	x	x	x		x	x	o
Overspeed	x	x	x		x	x	o
Low level radiator fluid	x		x		x		x
Low fuel level – main tank	x		x		x		x
Low fuel level – day tank	x		x		x		x
EPS supplying load	x		x		x		x
Generator control switch not in auto	x		x		x		x
High battery voltage	x		x		o		o
Low battery voltage	x		x		x		x
Battery charger AC failure	x		x		x		x
Remote emergency stop	x	x	x		x		x
Over Voltage		x				x	
Under Voltage	x	x	x		x	x	x
Lamp / horn test switch	x		x		x		x
Audible alarm silencing switch	x		x		x		x

CV; control panel visual indication. S: Shutdown of the EPSS. RA: Remote audible. x; Required. o: Optional

- I. Weather Protective Generator Set Enclosure: Manufactured with 14 gauge aluminum prepainted panels with interlocking seams, stainless steel mechanical fasteners, stainless steel hinges, and door holder latches. The doors will be strategically located to allow access for maintenance and visibility of the instruments on the face of the control panel. The doors will be key lockable. The engine radiator fan will draw air into the enclosure through a fixed aluminum intake louver and discharge the air through a gravity-open type aluminum discharge damper. The louver openings will be covered with metal screens to prevent rodents and birds from entering the enclosure. The engine

generator shall operate properly inside the enclosure at rated (full) load with the outdoor ambient temperature up to 110 degrees Fahrenheit. The enclosure will be wind rated in "miles per hour" by the manufacturer in accordance with the Wind-Borne Debris Region map published in the current Florida Building Code.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

- A. Provide field inspections and testing.

- B. Load and Bank Tests:

1. A load bank test will be performed at the Substantial Completion. This test shall be performed with resistive load banks, in the presence of the engineer and AHJ. The test shall be performed during regular business hours only - Monday - Friday, 8:00 AM to 5:00 PM.

- a. 0.5 hour 50%
- b. 0.5 hour 75%
- c. 3 hours 100%
- d. 10 minutes cool down

2. During test a written log shall be maintained at 15-minute intervals with the following:

- a. Ambient Air Temperature
- b. Amperes
- c. Hertz
- d. Oil Pressure
- e. Water Temperature
- f. Battery Charging
- g. Exhaust Stack Temperature
- h. Noise Level in dba (each side)
- i. Fuel for load test to be included in bid

- C. Test the alarm and shutdown circuits by simulating the faults, temperatures, and liquid levels. Verifying the alarm lights energize and the alarm horn sounds. Also verify the alarm silence feature works properly.

3.3 MANUFACTURER'S FIELD SERVICES

- A. The manufacturers field service representative shall visit the job site a minimum of three times (sign in each time) after construction begins to coordinate the

installation with the E.C and G.C. Provide assistance with concrete pad sizes and shapes, routing the control wiring, proper silencer installation methods, and day tank installation methods and control wiring.

3.4 ADJUSTING

- B. Adjust the generator output voltage and engine speed. Record for future use.

3.5 CLEANING

- A. Touch up paint any scratches in enclosures or housings.
- B. Clean the engine and generator surfaces of grease and oil.

3.6 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 260506.
- B. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide standby power.

END OF SECTION 263213

SECTION 263353 – STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Furnishing of all labor, materials, services, testing, and equipment necessary to provide and install a Static Uninterruptible Power Supply (UPS) system with an external maintenance bypass switch.
- B. Related Sections:
 - 1. All electrical specifications sections
 - 2. Section 262417 - Toll Equipment Clean Power Panelboard
 - 3. Section 263213 – Engine Generators

1.2 REFERENCES

- A. Applicable Standards
 - 1. UL 1778 - Underwriters Laboratory
 - 2. FCC rules, part 15 – Limits for a Class A digital device.
 - 3. IEEE C62.41 - Guide on Surge Voltages in AC Power Circuits Rated up to 600V.
 - 4. IEEE 519 – Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
 - 5. NFPA 70 - National Electrical Code

1.3 SYSTEM DESCRIPTION

1.3.1 General:

- 1. The static uninterruptible power supply (UPS) system will provide continuous, high quality, conditioned, AC output power to the Toll Equipment Clean Power Panelboard. The UPS will protect the Toll Equipment Clean Power Panelboard from power disturbances on the normal power distribution system due to power blackouts, brownouts, surges, or noise interference. Beginning with fully charged batteries, the UPS will provide high quality, conditioned output power for 15 minutes at full (100% rated) load with no AC input power to charge the batteries.
- 2. The UPS system will contain an internal isolation transformer to electrically isolate the output power from the input power. The UPS system will meet the NEC definition of a separately derived electrical distribution system.
- 3. The UPS system will be of modular design and will consist of multiple power modules and multiple battery modules. All modules will operate simultaneously

and share the load equally. Modules may be added or replaced while the UPS is on-line with no interruption or danger to the connected equipment.

1.3.2 MODES OF OPERATION

A. The UPS is designed to operate as a true on-line system in the following modes:

1. Normal - The critical AC load is continuously supplied by the UPS inverter. The input converter derives power from a utility AC source and supplies DC power to the inverter. The battery charger maintains a float-charge on the battery.
2. Back-up - Upon failure of utility AC power the critical AC load is supplied by the inverter. In this mode the inverter is powered from the battery. There is no interruption in power to the critical load upon failure or restoration of the utility AC source.
3. Recharge - Upon restoration of utility AC power, the input converter will automatically restart and resume supplying power to the inverter. The battery charger will resume recharge of the battery.
4. Automatic Restart - After a utility AC power outage and complete battery discharge, the UPS will automatically restart and resume supplying power to the critical load. In addition, the battery charger will automatically recharge the battery. This feature is enabled (factory default) and will be capable of being disabled by the user. The user will also be able to program two auto restart delay settings
 - a. Battery capacity % level
 - b. Countdown timer
5. Bypass - The internal bypass will provide an alternate path for power to the critical load and is capable of operating in the following manner:
 1. Automatic - In the event of an internal failure or should the inverter overload capacity be exceeded, the UPS will perform an automatic transfer of the critical AC load from the inverter to the bypass source.
 2. Manual - Should the UPS need to be taken out of service for limited maintenance or repair, manual activation of the internal bypass will cause an immediate transfer of the critical AC load from the inverter to the internal bypass source. The input converter, inverter, and battery charging operations will continue to operate, provided the control enable switch is in the "On" position.

1.3.3 PERFORMANCE REQUIREMENTS

1.3.3.1 SYSTEM

- A. Configuration: UPS 12 bay frame system may be configured as follows: 8, 12, 16 KVA redundant system, or 20kVA non-redundant system.
- B. Isolation: Input to output isolation is provided via the output transformer, regardless of the operating mode. (UPS or internal bypass)
- C. Remote Stop: The UPS provides provisions for remote stop (Emergency Power Off) capability.

1.3.3.2 AC INPUT SUPPLIED TO THE UPS

- A. Voltage Configuration: 208 or 240 VAC nominal. Ensure buildings with 3 phase power distribution systems are designed with 3 phase UPS systems. The UPS will be served by a dedicated feeder that is not spliced or tapped by other feeders. The UPS operating voltage range will be variable based upon output loading percentages as follows:

% UPS Load	Input Voltage
80 – 100%	170 VAC
60 – 80%	144 VAC
30 – 60%	127 VAC
0 – 30%	110C

- B. Frequency: 40 to 70 Hz.
- C. Input Current Distortion: 5% THD maximum at full load.
- D. Input Power Factor: 0.98 lagging at 100% rated load.
- E. Inrush Current: 150% of full load input current maximum for 3 cycles.
- F. Surge Protection: Sustains input surges without damage per criteria listed in IEEE C62.41, Category B.

1.3.3.3 AC OUTPUT

- A. Voltage Configuration: 240/120 VAC, single-phase, 3 wire-plus-ground or 208/120 VAC three phase, 4 wire plus ground. Refer to the power plans for AC output voltage. Ensure buildings with 3 phase power distribution systems are designed with 3 phase UPS systems.
- B. Voltage Regulation: +/- 3% steady state.
- C. Frequency Regulation: 60 Hz, +/- 0.5%.
- D. Frequency Slew Rate: field selectable from 0.5 to 5.0 Hz maximum per second.

- E. Bypass Frequency Synchronization Range: field selectable from 0.5 to 5.0 Hz maximum per second.
- F. Voltage Distortion: 3% total harmonic distortion (THD) maximum into a 100% linear load, 7% THD maximum into a 100% non-linear load with crest factor ratio of 3:1.
- G. Load Power Factor Range: 0.5 lagging to 1.
- H. Output Power Rating: Rated kVA at: 0.7 lagging power factor.
- I. Overload Capability: >100% - 110% indefinitely, 111% -150% for 10 seconds, 151% - 200% for 0.25 seconds. The load will be transferred to bypass when any of the above conditions are exceeded. >201% for min. 2 cycles, then shut down of UPS. Immediate shutdown into a short circuit.
- J. Voltage Transient Response: +/- 7% maximum for any load step up to and including 100% of the UPS rating.
- K. Transient Recovery Time: To within 1% of steady state output voltage within 96 milliseconds.

1.3.3.4 BATTERIES

- A. Internal Battery: The battery consists of flame retardant, valve regulated, lead acid cells. The UPS is suitable for installation inside a computer room per requirements of UL Standard 1778.
- B. Reserve Time: The UPS contains internal battery system to provide a reserve time of 7 minutes at 100% load with an equal number of power and battery modules fitted. The UPS includes provisions to fit additional battery modules internally if space permits. The UPS will interface with an external battery cabinet to extend the reserve time to 15 minutes when operating at 100% rated load with a resistive electrical load.
- C. Battery Recharge: To prolong battery life, the UPS includes temperature-compensated battery charging. When equal number of power modules and battery modules are fitted the battery charger is able to recharge the internal batteries to 90% charge in six hours at nominal input voltage and nominal ambient temperature.

1.4 ENVIRONMENTAL CONDITIONS

- A. Ambient Temperature
 - 1. Operating: UPS 0° C to +40° C; battery 20° C to 25° C for optimum performance.

2. Storage: UPS -20°C to $+60^{\circ}\text{C}$; battery -20°C to 25°C for maximum 6 months.

B. Relative Humidity

1. Operating: 5 to 95% non-condensing.
2. Storage: 5 to 95% non-condensing.

C. Altitude

1. Operating: To 10,000 feet. Derating/reduced operating temperature range required for higher altitudes.
2. Storage: To 30,000 feet.

D. Audible Noise

1. Noise generated by the UPS during normal operation does not exceed 62 dBA measured at three feet (one meter) from the surface of the UPS.

E. Electrostatic Discharge

1. The UPS is able to withstand a minimum 15 kV without damage and will not affect the critical load.

1.5 SHOP DRAWINGS

- A. Submit plan views and elevation views of each cabinet with overall dimensions and clearances required for maintenance procedures. Include battery sizing calculations or factory charts to indicate the number of batteries required to meet the reserve time when the UPS is operating at full (rated) load with no AC input power. Provide heat output and cooling air requirements. Also submit electrical diagrams including schematic and interconnection diagrams between the UPS and the MBS. Provide a site specific, point to point interconnection diagram on 11 x 17 inch paper. The site specific diagram will show the connection points and cable types required for the REPO station, Network Interface Card, and the MBS.
- B. The specified UPS system will be supplied with one printed user's manual and one user's manual on CD or DVD. Manuals include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step by step operating procedures, and routine maintenance guidelines.
- C.

1.6 WARRANTY

- A. The UPS manufacturer will warrant the UPS against defects in materials and workmanship for two years. The warranty will cover all parts for two years and onsite labor for two years. On site commissioning will be provided by a factory

trained service representative.

1.7 QUALITY ASSURANCE

1.7.1 Manufacturer Qualifications

- A. Minimum of ten year's experience in the design, manufacture, and testing of solid-state UPS systems is required.

1.7.2 FACTORY TESTING

- A. Before shipment, the manufacturer fully and completely tests the system to assure compliance with the specification. These tests include operational discharge and recharge tests on the internal battery to guarantee rated performance. The UPS ships completely assembled and all modules installed.

2.0 PRODUCT

2.1 FABRICATION

- A. All materials and components making up the UPS will be new, of current manufacture, and not in prior service except as required during factory testing. The UPS is constructed of replaceable subassemblies. All active electronic devices are solid-state.

2.1.2 WIRING

- A. Wiring practices, materials, and coding will be in accordance with the requirements of the National Electrical Code (NFPA 70) and other applicable codes and standards.

2.1.3 CABINET

- A. The UPS unit is comprised of: power module, battery module, control module, and user interface module housed in a single free-standing enclosure and meets the requirements of IP20. The UPS system is designed such that the battery modules may be installed into any module bay in the cabinet and power modules into any module bay in the top half of the cabinet. The UPS cabinet is cleaned, primed, and painted with the manufacturer's standard color. Casters and leveling feet are provided. 12 bay cabinet dimensions may not exceed 20 inches wide, 28 inches deep, and 53 inches high.

2.1.4 COOLING

- A. The UPS is cooled by forced air via internally mounted fans.

2.2 COMPONENTS

2.2.1 INPUT CONVERTER

- A. General: Incoming AC power is converted to a regulated DC output by the input converter for supplying DC power to the inverter. The input converter provides input power factor and input current distortion correction.

- B. AC Input Current Limit

The input converter is provided with AC input over current protection.

- C. Input Protection

- 1. The UPS has built-in protection against under voltage, over current, and overvoltage conditions including low-energy surges introduced on the primary AC source and the bypass source. The UPS can sustain input surges without damage per criteria listed in IEEE C62.41, Category A & B. The UPS cabinet contains an input breaker sized to supply full 20 kVA rated load and to recharge the battery at the same time.

- D. Battery Recharge

- 1. To prolong battery life, the UPS contains temperature-compensated battery charging. When an equal number of power modules and battery modules are installed the battery charger is able to recharge the internal batteries to 90% charge in six hours at nominal input voltage and nominal ambient temperature.

- E. Charger Output Filter

- 1. The battery charger is a DC power supply to minimize ripple current into the battery.

5.2.1 INVERTER

- A. General

- 1. The inverter converts DC power from the input converter output, or the battery, into precise regulated sine wave AC power for supporting the critical AC load.

- B. Overload

- 1. The inverter is capable of supplying current and voltage for overloads exceeding 100% and up to 200% of full load current. A visual indicator and audible alarm indicates overload operation. For greater currents or longer time duration, the inverter has electronic current-limiting protection to prevent damage to components. The inverter is self-protecting against any magnitude of connected output overload. Inverter control logic senses and disconnects the inverter from the critical AC load without the requirement to clear protective fuses. The load

will be transferred to bypass when any of the above conditions are exceeded.

C. Maximum Load Alarm

1. The user can set the alarm point to a value less than 100% rating such that the UPS will alarm before an overload condition or loss of redundancy is reached.

D. Output Frequency

1. The output frequency of the inverter is controlled by an oscillator. The oscillator will hold the inverter output frequency to $\pm 0.5\%$ for steady state and transient conditions. The inverter tracks the bypass continuously, providing the bypass source maintains a frequency within the user-selected synchronization range. If the bypass source fails to remain within the selected range, the inverter will revert to the internal oscillator.

E. Output Protection

1. The UPS inverter employs electronic current limiting.

F. Battery over Discharge Protection

1. To prevent battery damage from over discharging, the UPS control logic controls the shutdown voltage set point. This point is dependent on the rate of discharge.

5.2.2 DISPLAY AND CONTROLS

A. General

1. The front panel will consist of multiple status LEDs, switches, and a four line by twenty character LCD display for additional alarm/configuration information. All mimic display LED's are green in color and indicate the following:

AC Input

On Battery
Load On/Off
On Inverter
On Bypass

2. The UPS fault indicator is used with additional indicators and audible alarms to notify the user that a UPS fault condition has occurred. The color of the fault indicator LED is amber.

Replace Battery Module
Replace Power Module
Replace Control Module

On Bypass
Low Battery
Over Temp Warning
UPS Shutdown

3. If there is a fault condition, the UPS will attempt to maintain conditioned power to the load, or at minimum transfer to bypass. There will also be a visual indication on each module should the module fail and need to be replaced.
4. In addition to an audible/visual fault signal the UPS also records fault occurrences in a rolling event log. The event log on the standard unit can record up to 255 occurrences, with the oldest events discarded first, etc. The user has access to the event log through the LCD display. Every alarm and/or event recorded in the event log will contain a time and date stamp.

B. Audible Alarms

1. The volume of all audible alarms is at least 65dBA at a distance of three feet (one meter). An audible alarm is used in conjunction with the LED/LCD indication to indicate a change in UPS status.
2. The audible alarms enunciate for utility line loss, low battery (while on battery), and all other alarm conditions. For all alarm conditions, the user must look at the display to determine the cause of error/alarm. All alarm tones are a continual tone until the condition rectifies itself or the alarm is silenced. Once silenced, the audible alarm will not sound until a new alarm condition is present.

C. Alarm Silence Button

1. In addition to the load On/Off switch, the user interface includes an audible 'Alarm Silence' switch. If the alarm silence switch is pressed for one second, all current audible alarms will be disabled. If a new alarm occurs, or a cancelled alarm condition disappears and then re-appears, the audible alarm is re-enabled.

D. LCD Display

1. The LCD display is used to provide information to the user. The display is used to program ALL information (voltage, frequency, etc.) into the UPS. Any display values that require time/date will be 'year 2000' compliant.

2.2.4 AUTOMATIC BATTERY TEST

- A.** The UPS will initiate an automatic battery testing sequence periodically, at a programmed day and time of day, selectable by the end user. The user will be able to select the interval of the battery test and will be able to select 1, 2, 3, 4, or 6 week intervals, or can select to disable the automatic battery test.

- B. Should a battery failure occur, the battery module will disconnect itself from the critical DC bus and the UPS will immediately return to normal mode and fault signals (visual, audible, and remote via serial) will be communicated. No audible or remote (via serial/contact closures) indication of the battery test is communicated during the duration of the automatic battery test.
- C. Schedule the automatic battery test for a four week interval to occur on Wednesdays at 10:00 AM.

2.2.5 REMOTE EMERGENCY POWER OFF (REPO)

- A. The remote emergency power off function (REPO) allows the user to disable all UPS outputs in an emergency situation. The REPO, in order to be flexible, will be able to interface with either normally open (N.O.) or normally closed (N.C.) systems. The REPO is activated when a pair of contacts, external to the UPS, is activated. The REPO connection is through a simple terminal block type connector.
- B. The REPO function will not operate if no system control modules are present in the UPS or if the manual bypass switch is in the bypass position. The user must supply a means of interfacing with the REPO circuit to allow disconnecting the UPS input feeder breaker to remove all sources of power to the UPS and the connected equipment to comply with local wiring codes/regulations.
- C. Regardless of the UPS mode of operation when the REPO is activated, the UPS output will not be re-enabled until the following occurs:
 - REPO contacts are reset (closed if N.C. contacts are used and open if N.O. contacts are used)
 - Input circuit breaker is closed
 - Control enable switch is turned on
 - User interface on/off switch is depressed

2.2.6 INTERNAL BYPASS

A. GENERAL

1. An internal bypass circuit is provided as an integral part of the UPS. The bypass has an overload rating of 300% rated full load for 10 cycles and 1000% for sub-cycle fault clearing. The bypass control logic contains an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit provides a transfer of the load to the bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS.

B. AUTOMATIC TRANSFER

1. The transfer control logic automatically activates the internal bypass,

transferring the critical AC load to the internal bypass source, after the transfer logic senses one of the following conditions:

- Inverter overload capacity exceeded
- Inverter over temperature
- UPS fault condition

2. For inverter overload conditions, the transfer control logic inhibits an automatic transfer of the critical load to the bypass source if one of the following conditions exists:

- a. Inverter/Bypass voltage difference exceeding preset limits ($\pm 15\%$ of nominal)
- b. Bypass frequency out of preset limits ($\pm 5\%$ of nominal frequency)

C. AUTOMATIC RETRANSFER

1. Retransfer of the critical AC load from the internal bypass source to the inverter output is automatically initiated unless inhibited by the manual control. The transfer control logic inhibits an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

- a. Bypass out-of-synchronization range with inverter output
- b. Overload condition exists in excess of the inverter full load rating
- c. UPS fault condition present

D. MANUAL TRANSFER

1. In addition to the internal bypass function, the UPS has a manual bypass function. The manual bypass function is provided via a switch mounted on the bottom-front of the UPS, removal of the lower front bezel is required. The actual AC break time between inverter and bypass is less than four milliseconds.
2. The manual bypass provides a partial 'wrap-around' bypass, and is configured to wrap around the rectifier, battery charger, inverter, and battery in the same manner as the automatic bypass. The manual bypass does not wrap around the EMI filtering, over current protection or isolation transformer.
3. The UPS will initiate an audible alarm upon transfer to manual bypass. The audible alarm is capable of being silenced by the user. The alarm will continue to sound (unless silenced) while in bypass mode. This shall provide a reminder to the user that the load continues to be powered from utility supply alone.

2.2.7 INTERNAL BATTERY

- A. Flame retardant, valve regulated, gas recombination, lead acid batteries shall be used as a stored-energy source for the specified UPS system. The battery is housed in separate replaceable modules that slide into any open bay of the UPS cabinet, and are sized to support the inverter at rated load and power factor, in an ambient temperature between 20° and 25° C, for a 7 minutes reserve time. The expected life of the battery is 3 to 5 years or a minimum 250 complete discharge cycles. For extended battery reserve time, additional battery modules may be added if the frame size allows; external battery cabinets are available as an option.

2.3 COMMUNICATIONS

- A. The UPS allows for flexibility in communications via two DB9 communication ports and four Intellislot ports on the rear of the UPS. The UPS will communicate with the FTE SCADA system using an IS-WEBCARD card to provide HTTP supported SNMP communication over a local area network. The IS-WEBCARD will support 10/100Mbit Ethernet over unshielded twisted pair connection. Install a category 5e cable, 4 pair, copper UTP, CMP rated, network communication cable with RJ45 connectors. Label each end of the cable "NET SW - UPS". Ensure the communications cable is routed in ¾" conduit between the UPS and the Foundry Ethernet router switch in the Recorder Room (or Toll Equipment Building).

2.4 EXTERNAL MAINTENANCE BYPASS SWITCH

- A. The external maintenance bypass switch (MBS) will provide complete "wrap around" protection and allow the UPS cabinet to be safely removed from service. The MBS will accept two incoming sources of power. Input "Source A" will be supplied from the UPS output. Input "Source B" will be from an alternate "bypass" feeder. The UPS feeders and/or the alternate "bypass" feeder may not be spliced or tapped by other conductors. When the MBS is in the "Source A" position, the Toll Equipment Clean Power Panel will receive power from the UPS. When the MBS is in the "Source B" position, the Toll Equipment Clean Power Panel will receive power from the alternate "bypass" feeder. When the MBS is in the Off position, the Toll Equipment Clean Power Panel will be de-energized.

3.0 FIELD SERVICES

3.1 FIELD QUALITY CONTROL

The following inspections and test procedures will be performed by factory trained field service personnel during the UPS start-up and commissioning.

3.1.1 Visual Inspection

- A. Inspect equipment for signs of shipping or installation damage.
- B. Verify installation per drawings.

- C. Inspect cabinets for foreign objects.
- D. Verify neutral and ground conductors are properly sized and configured.

3.1.2 Mechanical Inspection

- A. Check all power modules are correctly fitted.
- B. Check all battery modules are correctly fitted.
- C. Check all terminal screws, nuts, and/or spade lugs for tightness.

3.1.3 Electrical Inspection

- A. Confirm input voltage and phase rotation is correct.
- B. Verify bypass voltage jumper is correct for voltages being used.

3.2 UNIT START-UP AND SITE TESTING

- A. The manufacturer's field service personnel will provide site testing for the UPS system. Site testing consists of a complete test of the UPS system and the associated accessories supplied for the UPS system including the external maintenance bypass switch.

3.2.1 A PARTIAL BATTERY DISCHARGE TEST

- A. A partial battery discharge test will be conducted as part of the UPS system standard start-up procedure. Perform the test as follows:
 - 1. Verify the external maintenance bypass switch (MBS) in the "Source A" position. (UPS providing the input power to the Clean Power Panel).
 - 2. Connect 5 KW of resistive portable load to the branch circuit breakers on the Toll Equipment Clean Power Panelboard.
 - 3. Start the backup generator and verify that emergency generator power is available at the ATS. Open the circuit breaker feeding the normal (utility) power to the Automatic Transfer Switch. The ATS should switch to the Emergency Position.
 - 4. Ensure the UPS is operating normally with no alarms while receiving power from the backup generator and while powering the 5 KW resistive portable load.
 - 5. Open the circuit breaker for the feeder that serves the UPS and allow the UPS batteries to discharge 50%. Record the number of minutes it takes for the batteries to discharge to 50% of their capacity. Record all UPS alarms.
 - 6. Close the circuit breaker serving the UPS and verify that the UPS is operating normally with no alarms while receiving power from the backup generator and the UPS batteries are charging.
 - 7. Close the circuit breaker feeding the normal (utility) power to the

Automatic Transfer Switch and verify that the ATS switches to the Normal position within 5 minutes.

8. Allow the backup generator to cool down for 5 minutes and turn off the backup generator. Leave the backup generator control switch in the “AUTO” position.
9. The test results will be documented, dated, and signed by the UPS technician and the Electrical Contractor. The test results will be turned over to the Department for future reference.

3.2.2 EXTERNAL MAINTENANCE BYPASS SWITCH TEST

- A. An external maintenance bypass switch test will be conducted as part of the standard UPS start-up procedure. Test the external maintenance bypass switch (MBS) as follows:
 1. Connect 5 KW of resistive portable load to the branch circuit breakers on the Toll Equipment Clean Power Panelboard. Open all other branch circuit breakers.
 2. Place the MBS in the “Source A” position. (UPS providing the input power to the Clean Power Panel). For 3 phase distribution systems measure and record the phase rotation at the input of the Toll Equipment Clean Power Panelboard with the MBS in the “Source A” position.
 3. Move the MBS to the Off position. Verify that no voltage exists on the Toll Equipment Clean Power Panelboard.
 4. Move the MBS to the “Source B” position. Verify that proper voltage exists (Phase to Phase, Phase to Neutral, and Phase to Ground) at on the Toll Equipment Clean Power Panelboard and that power is being delivered to the 5 KW load. For 3 phase systems also verify that the phase rotation of “Source B” is compatible with “Source A”.
 5. Turn off the UPS and open the UPS feeder breaker. Verify the external maintenance bypass switch is operating satisfactorily and the UPS is completely bypassed and electrically isolated.
 6. Close the UPS feeder breaker and turn on the UPS. Verify the UPS is operating properly.
 7. Place the MBS in the “Source A” position. (UPS providing the input power to the Clean Power Panel).
 8. Disconnect the 5 KW of resistive portable load on the Toll Equipment Clean Power Panelboard.

9. The test results will be documented, dated, and signed by the UPS technician and the Electrical Contractor. The test results will be turned over to the Department for future reference.

3.3 REPLACEMENT PARTS STOCKING

- A. Replacement parts will be available through a local distributor within 100 miles of the job site. The replacement parts including power modules and battery modules for the UPS model installed at this site will be available 24 hours a day, 7 days a week, 365 days a year.

SECTION 263600 - AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Automatic transfer switch (ATS)
- B. Manual transfer switch (MTS)

1.2 RELATED SECTIONS

- A. Section 260553 – Identification for Electrical Systems: Engraved nameplates.
- B. Section 263213 - Package Engine-Generator System: Testing requirements.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code
- B. NEMA ICS 1 - General Standards for Industrial Control and Systems
- C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies
- D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- E. U.L. – 1008
- F. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
- G. NFPA 101 – Life Safety Code
- H. NFPA 110 – Emergency and Standby Power Systems

1.4 SUBMITTALS

- A. Submit under provisions of Section 260501.
- B. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory

Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 260501.
- B. Operation Data: Include instructions for operating equipment. Include instructions for operating equipment under emergency conditions [when engine generator is running.]
- C. Maintenance Data: Include routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience, and with service facilities within 100 miles of Project.
- B. Supplier: Authorized distributor of specified manufacturer with minimum three years experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, NFPA 110, and NFPA 101.
- B. Furnish products listed and classified by UL and acceptable to authority having jurisdiction as suitable for purpose to supply power for Life Safety emergency systems.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 260500.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of transfer switch for one year from Date of Substantial Completion.

1.11 MAINTENANCE MATERIALS

- A. Provide maintenance materials and operators manuals.
- B. Provide two of each special tool required for maintenance or manual operation.

1.12 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 110.
- B. Maintain one copy of document on site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Russelectric (RMTD Model 2000)
- B. Automatic Switch Company (ASCO 7000 series)
- C. Substitutions: See specifications, Section 260502.

2.2 AUTOMATIC TRANSFER SWITCH(ES)

Description: NEMA ICS 2, automatic transfer switch(es), 2 pole, 3 pole or 4 pole as shown on the electrical drawings.

The transfer switch shall be equipped with a microprocessor based control system to provide all the operational functions of the automatic transfer switch. The controller shall have a real time clock with NiCad battery back up.

The controller shall include a 20 character, LCD display, with keypad, which allows access to the system. The controller shall have password protection.

Provide transfer switch(es) with an equipment grounding lug sized to accept the grounding conductors as shown on the electrical drawings.

The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements.

The transfer switch shall be double-throw, actuated by two electrical operators momentarily energized, and connected to the electrical operator by a simple over center type linkage with a normal transfer time of 400 milliseconds. The transfer switch shall be capable of transferring successfully in either direction.

The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs and shall be silver-tungsten alloy. Separate arcing contacts, with magnetic blowouts, shall be provided on all transfer switches. Interlocked molded case circuit breakers or contactors are not acceptable.

Control components and wiring shall be front accessible.

All control wires shall be 600-Volts SIS switchboard type. All control wire termination's are to be identified with tubular, sleeve-type markers.

The transfer switch shall be mounted in a NEMA 1 enclosure, unless otherwise indicated. Enclosure, unless otherwise indicated. Enclosure shall be fabricated from 12-gauge steel. The enclosure shall exceed UL-1008 minimum wire bending space.

Each transfer switch shall be equipped with a door-mounted pocket, housing an operations and maintenance manual.

The switch shall come equipped with copper/aluminum solderless bolted pressure-type lugs rated for 90 degrees C.

All enclosure doors shall have three point latches.

All bolted connections shall have Belleville compression-type washers.

Control wires shall be terminated with locking spade-type connectors.

Solid-state components shall have an operating range of -20°C to +55°C and shall meet IEEE Standard 472-1974.

Switch shall be top or bottom accessible.

Switch shall be capable of replacing main contacts without removing main power cables.

Main contacts shall be visible for inspection without any major disassembly of the transfer switch.

Withstand Ratings

1. Switch(es) shall be listed by Underwriters' Laboratories, Inc., Standard UL-1008 with 3-cycle short circuit closing and withstand values for any manufacturers breaker or fuses as follows:

RMS Symmetrical Amperes 480 VAC

Amperes	Closing and Withstand	Fuse Rating
100 - 400	42,000	200,000
600 - 800	65,000	200,000
1000 - 1200	85,000	200,000
1600 - 4000	100,000	200,000

2. During the 3-cycle closing and withstand tests, there shall be no contact welding or damage, and there shall be contact continuity across all phases after completion of testing. The 3-cycle tests shall be performed without the use of current limiting fuses. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories, Inc.
3. When conducting temperature rise tests to UL-1008, the manufacturer shall include post endurance temperature rise tests to verify the ability of the transfer switch to carry full-rated current after completing the overload and endurance tests.

2.3 PRODUCT OPTIONS AND FEATURES

- A. Adjustable, 3-phase sensing of the normal source and emergency source. Factory set to pick up at 90% and drop out at 80% of rated voltage. The adjustable frequency picks up at 95% and dropout at 90% of rated frequency. The switch shall also include phase sequence monitoring on the normal and emergency source.
- B. Time delay to override momentary normal source power outages. This will delay the engine start signal and transfer switch operation. Adjustable 0 - 999 seconds. Field adjusted to 1 second during start-up.
- C. Time delay on transfer to emergency. Adjustable 1-300 seconds. Field adjusted to 1 second during start-up.
- D. Time delay to control contact transition time on transfer to either source. Adjustable 1-300 seconds. (Delayed Transition Only) Field adjusted to 2 seconds.
- E. Time delay on retransfer to normal, adjustable 0-9999 seconds, with engine overrun to provide adjustable 0-9999 second unloaded engine operation after

retransfer to normal. Field adjust the retransfer to normal time delay to 60 seconds. Field adjust the unloaded engine cool down time delay to 300 seconds.

- F. “Load Test Switch” to simulate a normal power failure. (Maintained type)
- G. Contact to close on failure of normal source to initiate engine starting or other customer functions.
- H. Contact to open on failure of normal source to initiate engine starting or other customer functions.
- I. Green pilot light to indicate switch in normal position.
- J. Red pilot light to indicate switch in emergency position.
- K. Plant exerciser with (10) 7-day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise the generating plant. Adjustable type with minimum of 1-minute increments and battery back-up. Also include selection of either “no load” (ATS will not transfer during exercise period) or “load” (ATS will transfer during exercise period).
- L. An LCD display, with 1% accuracy, shall show all three separate phase to phase voltages simultaneously, for both the normal and emergency source. A digital LCD frequency readout shall display frequency for both the normal and emergency source.
- M. (2) Auxiliary contacts rated 10 Amp, 120 volts AC closed when the ATS is in the normal position. Wired to a terminal strip.
- N. (2) Auxiliary contacts rated 10 Amp, 120 volts AC, closed when the ATS is in the emergency position. Wired to a terminal strip.
- O. Adjustable relay to prevent transfer to emergency until voltage and frequency of generating plant have reached acceptable limits. Factory set at 90% of rated value.
- P. (2) time delay contacts that open simultaneously just prior to transfer in either direction. These contacts close after a time delay (adjustable 1-300 seconds) after transfer. Factory set at 3 seconds.
- Q. (2) time delay contacts that open simultaneously 1-300 seconds (adjustable) before transfer in either direction and re-close instantaneously after transfer. Factory set at 5 seconds.

- R. (2) time delay contacts that open simultaneously 5 seconds prior to transfer in either direction (1-300 seconds adjustable). The contacts re-close 3 seconds after transfer.
- S. Automatic synchronizing check relay to prevent retransfer from emergency to normal until the normal and emergency sources are within acceptable limits.
- T. The transfer switch shall be equipped with an external manual operator handle that allows manual operation of the switch without opening the enclosure door.

2.4 AUTOMATIC SEQUENCE OF OPERATION

- A. The transfer switch shall be equipped to provide the following sequence of operation:
 - 1. Should the voltage of the normal source drop below a preset value (adjustable 70-100%) set at 80% on any phase after a time delay (adjustable 0.5-6 seconds) set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.
 - 2. The transfer switch shall transfer to emergency when the generating plant has reached a preset value (adjustable 90-100%) set at 90% of rated voltage and frequency.
 - 3. After restoration of normal power on all phases to a preset value (adjustable 70-100%) set at 90% of rated voltage, an adjustable time delay period of 0-31 minutes (factory set at 5 minutes) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
 - 4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a 5-minute period before shutting down.
- B. Transfer switches shall transfer to emergency within the time limits as required by the National Electrical Code for each branch of emergency power system (10 seconds for life safety).
- C. When more than one emergency branch is shown, time delay relays shall be provided on the transfer to emergency operation for critical and equipment branch transfer switches. Time delay shall be adjustable 1-300 seconds and shall be adjusted in stages with the limits of the N.E.C. and as follows:
 - 1. Life Safety Branch - no time delay on transfer to emergency.

2. Critical Branch - shall transfer to emergency after life safety branch has transferred to emergency and generator has recovered to 90% of rated voltage and frequency.
3. Equipment Branch - shall transfer to emergency after critical branch has transferred to emergency and generator has recovered to 90% of rated voltage and frequency.

NOTE: These time delays shall not effect or be a function of contact transition time as required above.

2.5 ENCLOSURE

- A. Enclosure: ICS 6, Type 1.12.
- B. Finish: Manufacturer's standard gray enamel.

2.6 SURGE SUPPRESSION

- A. Provide surge suppressor on all transfer switches. Refer to section 264313 for suppressor requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions are suitable for the ATS.
- B. Verify that surface is suitable for transfer switch installation.

3.2 INSTALLATION

- A. Install transfer switches in accordance with manufacturer's instructions. Provide all associate control wiring to the generator as required.
- B. Provide engraved plastic nameplates under the provisions of Section 260553.
- C. Provide all interface control wiring and conduit as required to provide require emergency operation of equipment on project as applicable, i.e. elevators, building automation system, fire alarm control panel, smoke control system, etc.

3.3 MANUFACTURER'S FIELD SERVICES

- A. The manufacturers field service representative shall visit the job site a minimum of three times (sign in each time) after construction begins to coordinate the installation with the E.C and G.C. Provide assistance with concrete pad sizes and shapes, proper

mounting instructions for each ATS and the quantity and routing of ATS control wiring.

3.4 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 260506.
- B. Demonstrate the proper operation of each transfer switch in normal and emergency modes. Operate each ATS manually in the presence of the Department's representative.

END OF SECTION 263600

SECTION 264113 – LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Description of Systems: A lightning protection system shall be placed on the structure as described herein, by experienced installers in compliance with provisions of Code for NFPA 780, National Fire Protection Association, and Underwriters' Laboratories. All equipment to protect the existing and new building against damage by lightning shall be included whether or not specifically called for herein. An U.L. Master Label (UL-96A) for the system and a witness of grounding form shall be required.
- B. Materials shall comply in weight, size and composition with the requirements of Underwriters' Laboratories and the National Fire Protection Code relating to this type of installation, and shall be U.L. Labeled.
- C. All materials other than air terminal and conductors shall be heavy duty cast type. (No stamped metal materials are acceptable.)

1.2 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of lightning protection of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
 - 1. Thompson Lightning Protection, Inc.
 - 2. Heary Brothers Lightning Protection
 - 3. Independent Protection Company
- B. Installer: Firms with at least five (5) years of successful installation experience on projects with electrical installation work similar to that required for the project.
 - 1. Maxwell Lightning Protection of Florida
 - 2. Other qualified installers.

1.3 SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. Shop Drawings:
 - a. Shop drawings shall be submitted and reviewed before work is started. Drawings shall include full layout of cabling and points, and connections.

- b. Submit shop drawings marked with roofing manufacturer's stamp of approval. Failure to do so will result in rejection of submittal.
- 2. Product Data: Product data shall be submitted on all equipment to show compliance with this Section of the Specifications and shall include manufacturer's written recommendations for installation.

PART 2 - PRODUCTS

2.1 AIR TERMINALS

- A. Air terminals shall be solid copper or aluminum and shall have proper base support for surface on which they are attached, and shall be securely anchored to the surface. Terminals shall project a minimum of 10" above top of object to which attached.

2.2 CONDUCTORS

- A. Roof conductors shall consist of copper or aluminum complying with the weight and construction requirements of the Code, and shall be coursed to interconnect with air terminals, and in general, provide a two-way minimum path to ground. The angle of any turn shall not exceed 90°, and shall provide an approximately horizontal or downward course. Down conductors shall be copper, and shall be installed in PVC conduit and hidden within the structure. Radius of bends shall not be less than 8 inches.

2.3 FASTENER

- A. Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor. Where fasteners are to be mounted in masonry's or structural work, they shall be furnished to the Masonry or Structural Contractor so they may be installed during construction of the project.

2.4 GROUND CONNECTIONS

- A. Ground connections shall be made in accordance with requirements of all applicable codes. Ground rods shall be placed a minimum of two (2) feet from building foundations. In addition to above artificial grounds, one down conductor of each two-path system shall be connected to water piping system with approved water pipe type strap connector. All ground rods shall be sectional, 5/8" x 20' minimum copperweld type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be made in an inconspicuous manner with conductors coursed to conceal equipment as much as possible. down conductors shall be concealed within structure, and shall be run in 1" PVC conduit. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor.
- B. Bond to main service electrical ground.
- C. Bond to incoming metallic telephone and communications surge protectors.
- D. Provide access boxes at ground rods to permit inspection of connections. Boxes may be reinforced plastic body and cover in landscape areas and shall be concrete with cast iron covers in paved areas.

3.2 TESTING

- A. Test all ground rods individually to ensure the maximum resistance to ground does not exceed 5 ohms, and every rod that fails the test shall be driven deeper, using additional lengths of ground rod if necessary until the required resistance is achieved.
- B. Upon completion of installation of the grounding and bonding systems, test ground resistance of the system with a ground resistance tester. The resistance of the grounding system shall not exceed five ohms. Where tests show resistance to ground exceeds five ohms, take appropriate action to reduce resistance to three ohms or less by driving additional ground rods; then retest to demonstrate compliance. Install additional rods at least eight feet apart.
- C. Method for testing individual ground rods and the complete grounding and lightning protection system shall be by the three point method. Test probes shall be placed a minimum of 30 feet and 60 feet from the rod being tested. Furnish a written report of all test results for all ground rods and the grounding system, witnessed by the Department's representative.
- D. All underground connections shall be made using exothermic welds. All ground rod connections shall be welded.
- E. All ground wires shall be terminated with compression lugs and bolted with ½ inch stainless steel nuts and bolts to the 3/8 inch by 6 inch by 24 inch wall mounted copper ground bus near the main service equipment.

SECTION 264313 – TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 DESCRIPTION OF SYSTEM

- A. Provide and install all materials, labor and auxiliaries required to furnish and install complete surge suppression for the protection of building electrical and electronics systems from the effects of line induced transient voltage surge and lightning discharge as indicated on drawings or specified in this section for power systems with voltages between 120VAC to 480VAC (single phase or three phase) and for all communications and alarm systems (i.e. data, voice, security, etc.)
- B. Provide surge suppression equipment for the following equipment:
 - 1. Each main electrical service panel as shown on the drawings. Include branch circuit breakers in the main service panel to disconnect and protect the surge suppressor.
 - 2. Each distribution and branch panels as shown on the drawings. Include branch circuit breakers in the distribution and branch panels to disconnect and protect the surge suppressors.
 - 3. All or any electronic equipment installed under Division 26 including electronic time clocks, controls systems, security, telephone, etc.
 - 4. All or any electronic equipment installed under Division 25 including: electronic time clocks, halon systems, control systems, building management systems, etc.
 - 5. Site lighting pole light circuits (at pole).
 - 6. Additional locations as required by NFPA 780.
 - 7. On each emergency power feeder entering the building and before the emergency feeder is connected to Automatic Transfer Switch.
 - 8. On any and all lease telephone lines.
 - 9. Existing suppressors shown on the drawings shall remain active unless note for replacement.
- C. It is understood that each manufacturer or the electronic equipment being protected has different circuit requirements; therefore this specification is a modified performance specification. Provide the best type suppressor that matches these specifications and matches the equipment being protected.
- D. Install surge suppressors on the outside of control panels and electrical equipment.

1.2 REFERENCES

- A. UL 1449 3rd Edition listed
- B. UL 1283 listed
- C. ANSI/IEEE C62.41.1-2002, C62.41.2-2002, C62.45-2002

- D. NEMA LS-1 B 1992 Section 2.2.7
- E. IEEE Std. 1100-1999 Section 8.6.1
- F. ANSI C84.1, American National Standard for Electric Power Systems and Equipment B Voltage Ratings (60 Hertz).
- G. NFPA 780 - Lightning Protection Code, latest edition.
- H. NFPA 70 - National Electrical Code(NEC), current adopted year. Article 285 (2002 and later edition)

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications
- B. SVR: Suppressed Voltage Rating
- C. SPD: Surge Protection Device

1.4 SUBMITTALS

- A. Submit under provisions of the General Requirements of the Contract Documents and Section 260501.
- B. Product Data: For each type of product indicated. Include rated capacities; bill of materials of number of MOV's installed per phase with MOV part number and surge current rating, operating weights, operating characteristics, furnished specialties, and accessories.
- C. Product Certificates: For transient voltage suppression devices, signed by product manufacturer certifying compliance with the following standards:
 - 1.UL 1283
 - 2.UL 1449 3rd Edition certification listing and classification page
 - 3.NFPA 70, National Electrical Code - NEC 285 latest edition
- D. Field quality-control test reports, including the following:
 - 1.Test procedures used.
 - 2.Test results that comply with requirements.
 - 3.Failed test results and corrective action taken to achieve requirements.
- E. Operation and Maintenance Data: For transient voltage suppression devices to include in emergency, operation, and maintenance manuals.
- F. Warranties: Special warranties specified in this Section. Submit Product Data for each type of suppressor:

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance (O&M) data as called for in Section 260507.

B. O&M data to include:

1. All approved shop drawings, product data, and/or cutsheets.
2. Installation, connection, and maintenance information on each type of surge suppression.
3. Procedure and/or timetable for recommended periodic inspection of devices to determine continued usefulness, as applicable.

1.6 QUALITY ASSURANCE

- A. All surge suppression devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for electrical and electronics systems equipment.
- B. Manufacturing facility shall operate a Quality System Certified as ISO 9001:2000 (or latest version) Compliant.
- C. CE Low Voltage Directive Compliant
- D. The surge suppressor manufacturer shall provide requested technical assistance through support (including on-site as needed) by a factory-trained representative.
- E. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- F. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements".
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- H. Product Standards:
1. Comply with IEEE C62.41.1, "IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits", IEEE C62.41.2, "IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits", and test devices according to IEEE C62.45, "IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits".
 2. Comply with NEMA LS 1, "Low Voltage Surge Protective Devices".

3. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449 3rd Edition, "Transient Voltage Surge Suppressors".

4. NFPA 70, National Electrical Code article 285 latest edition

1.7 REGULATORY REQUIREMENTS

- A. Equipment Certification: Surge suppression equipment shall be listed by Underwriter Laboratories, shall bear the U.L. seal and be marked in accordance with referenced standard. Surge suppression equipment shall be U.L. listed and labeled for intended use.
- B. Surge suppression devices shall be installed and located in accordance with requirements of all applicable National Fire Protection Association (NFPA) codes (including NFPA 780 and NFPA 70).
- C. Comply with all standards and guides as listed under "References" above.

1.8 COORDINATION/PROJECT CONDITIONS

- A. Verify proper grounding is in place.
- B. Verify proper clearances, space, etc. is available for surge suppressor.
- C. Coordinate so that proper overcurrent device, as recommended by manufacturer, is installed to feed each surge suppression device.
- D. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- E. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 - 3. Humidity: 0 to 85 percent, no condensing.
 - 4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.9 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Substantial Completion.
- B. For Data line Suppressors, Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within two years from date of Substantial Completion.
- C. Any suppressor, that shows evidence of failure or incorrect operation during the warranty period (to include failure of visual failure indicators) shall be replaced or repaired by the manufacturer during the warranty period. The manufacturer shall provide replacement units to the Department for installation

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. (Any product that meets or exceeds the performance of the following manufacturers will be considered.)
 - 1.Advanced Protection Technologies
 - 2.Liebert
 - 3.L.E.A. International

2.2 SERVICE ENTRANCE SURGE PROTECTION DEVICE

- A. Surge Protection Device Description: Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories:
 - 1.TVSS shall be UL 1449 3rd Edition listed.
 - 2.Install external TVSS to distribution equipment with installation leads as short as possible.
 - 3.TVSS marked with a 200kA short-circuit current rating.
 - 4.Fabrication using bolted compression lugs for internal wiring.
 - 5.Integral disconnect switch
 - 6.Field replaceable modules
 - 7.Modes of Protection: Line to Neutral, Line to Ground, Line to Line, and Neutral to Ground
 - 8.Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
 - 9.LED indicator lights for power and protection status.
 - 10.Audible alarm with silence switch.
- B. Peak Surge Current Rating: 160 kA per phase with less than ½ nanosecond response time.

- C. Connection Means: Permanently wired, connected on the load side of the service entrance overcurrent protection, and meet the TVSS manufacturer's instructions for overcurrent protection (breaker or fuse size).
- D. Protection modes and UL 1449 SVR for circuits with voltages of 120/240V, 1-Phase, 3-Wire shall be as follows:
 - 1. Line to Neutral: 330V for 120/240V, 1PH, 3W
 - 2. Line to Ground: 330V for 120/240V, 1PH, 3W
 - 3. Neutral to Ground: 330V for 120/240V, 1PH, 3W
 - 4. Line to Line: 600V for 120/240V, 1PH, 3W

2.3 SUPPRESSOR FOR DISTRIBUTION PANELBOARDS

- A. Surge Protection Device Description: Non-modular design incorporating sine-wave-tracking type with the following features and accessories:
 - 1. TVSS shall be UL 1449 2nd Edition listed.
 - 11. Install external TVSS to distribution equipment with installation leads short as possible.
 - 12. TVSS marked with a 200kA short-circuit current rating.
 - 13. Modes of Protection: Line to Neutral, Line to Ground, Line to Line, and Neutral to Ground
 - 14. LED indicator lights for power and protection status.
 - 15. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
- B. Peak Surge Current Rating: 80 kA per phase
- C. Protection modes and UL 1449 SVR for circuits with voltages of 120/240V, 1-Phase, 3-Wire shall be as follows:
 - 1. Line to Neutral: 330V for 120/240V, 1PH, 3W
 - 2. Line to Ground: 330V for 120/240V, 1PH, 3W
 - 3. Neutral to Ground: 330V for 120/240V, 1PH, 3W
 - 4. Line to Line: 700V for 120/240V, 1PH, 3W

2.4 SUPPRESSORS FOR POWER LINE CORD/DIRECT WIRED (120 VAC) SUPPRESSORS

- A. Surge Protection Device Description: Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories:
 - 1.SPД shall be UL 1449 2nd Edition listed.
 - 2.15 & 30 Amp, 120 V rated. All continuous current bearing components must be either 15 or 30 Amp rated, minimum; depending on Location Load usage.
 - 3.Suppressors shall provide three suppression modes: Line-to-neutral, line-to-ground, and neutral-to-ground.
 - 4.Suppressor shall provide a pulse life rating of 3,000 amperes (8/20μs waveform) every thirty (30) seconds for 2,000 occurrences.
- B. Peak Single-Impulse Surge Current Rating: 13 kA per phase
- C. Protection modes and UL 1449 SVR for circuits with voltages of 120/240V, 1-Phase, 2-Wire shall be as follows:
 - 1. Line to Neutral: 330V for 120V, 1PH, 2W
 - 2. Line to Ground: 330V for 120V, 1PH, 2W
 - 3. Neutral to Ground: 330V for 120V, 1PH, 2W

2.5 DATA LINE SUPPRESSORS

- A. Surge Protection Device Description: Modular DIN RAIL design.
 - 1.Must be designed to U.L. 497B and/or UL-497B listed and labeled.
 - 2.Plug-in replaceable DIN RAIL modules
 - 3.Suppressor shall provide a pulse life rating of 3,000 amperes (8/20μs waveform) every thirty (30) seconds for 2,000 occurrences.
- B.Peak Single-Impulse Surge Current Rating: 20 kA per phase.
- C.Maximum clamping voltage at 10,000 amperes, 8/20μs current waveform, shall not exceed the peak of the normal applied signal voltage by 200%.

2.6 TELEPHONE LINE SUPPRESSORS

- A. Surge Protection Device Description: Modular design.
 - 4.Must be designed to U.L. 497B and/or UL-497B listed and labeled.
 - 5.Plug-in replaceable modules design to fit on standard M1-50 block
 - 6.Must be installed with matching ground rail
 - 7.Provide applicable breakdown voltages of either 270V, 200V, or 65V

- B. Peak Single-Impulse Surge Current Rating (10x1000 μ s): 200A Tip and Ring to Ground

2.7 ENCLOSURES

- A. NEMA Type 1 enclosures shall be used for all enclosures inside of the building and NEMA Type 3R enclosures for exterior applications.

2.8 ADDITIONAL SUPPRESSOR PERFORMANCE CRITERIA

- A. Exterior Lighting Poles.

1. UL-1449 2nd Ed. Listed and/or UL-1449 Registered (backwards RU)
2. L-G, N-G, L-N and/or L-G, L-L Protection modes, (as applicable).
3. MOV shunt type protection.
4. Indicator lamps for each protected phase.
5. Modular solid state, fail-safe, 30 Ampere models.
6. Enclosures:
 - a. Encapsulated, fire retardant, high impact, phenolic or plastic housing or metal enclosure.
7. Peak Let-Through Voltage, ANSI/IEEE Std. C62.41-Category B3/C1, (L-N), 6 kV x 3 kA, (8 x 20 μ s):
 - a. 120V, 1t: < 300 V
 - b. 208V, 1t: < 600 V
 - c. 240V, 1t: < 600 V

2.9 TERMINATIONS

- A. Provide terminals sized for circuits required on project.
- B. Where surge suppression modules are intended for mounting on >M= block assembly, provide M block assembly complete with grounding system that mates with surge suppression equipment.

2.10 TERMINAL CABINETS

- A. Provide terminal cabinets for all terminations and surge suppression equipment serving communications and alarm equipment including 120VAC power surge suppressor. Size terminal cabinets as required facilitating installation of terminations and surge suppression in a neat and workmanlike manner.
- B. Terminal cabinet to meet specifications in Section 262716 unless specifically manufactured for use.

- C. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturer will be considered.)

- 1. Advanced Protection Technologies

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide, install and connect suppressor at first piece of electrical equipment (panel, switchboard, ATS, etc.) that the electrical service encounters as it enters the facility as indicated on the drawings.
- B. Provide, install and connect suppressor at each branch panel as noted on drawings.
- C. Provide, install and connect suppressor at each Automatic Transfer Switch (ATS) in project as shown on drawings.
- D. Provide, install and connect surge suppressor in pole hand hole of all exterior lighting poles.
- E. Provide, install, and connect surge suppression at location where Division 27 and 28 equipment is connected to line voltage (120V). Provide cords and receptacles as required to connect TVSS equipment to equipment being protected and maintain U.L. listing.
- F. Extreme care shall be taken by contractor to assure a properly surge protected system.
- G. Surge protection equipment must be selected by contractor to match the equipment being protected including wire sizes, operating volts, amps, and circuit impedance.
- H. Installation of surge protection equipment and its grounding must be per manufacturer's recommendations to assure short and proper ground paths.

3.2 EQUIPMENT SELECTION

- A. Coordinate with suppliers and installers of all equipment being protected and provide surge suppression equipment that meets these specifications on respective equipment, wires, etc.

3.3 INSTALLATION OF SUPPRESSORS

- A. Suppressors for other than Division 27 and 28 equipment shall be installed as close as practical to the electric panel or electronic equipment to be protected, consistent with available space.
- B. Suppressors for Division 27 and 28 equipment power source shall be coordinated with equipment contractor. Locate in terminal cabinet with surge suppression equipment and bond together.
- C. Suppressors shall be close-nipped to the device being protected in a position nearest the neutral bus (if present) to minimize wire lead length between suppressor and the buses or control breaker to which the suppressor connects. Suppressor leads shall not extend beyond the suppressor manufacturer's recommended maximum lead length without specific approval of the engineer.
- D. Location shown on drawings is diagrammatic only.
- E. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be as short and as straight as possible and be consistent with recommended industry practices for the system on which these devices are installed.
- F. Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated herein shall be accomplished using #6 AWG core copper conductor and approved connections unless otherwise noted. Referenced to a common earth ground.
- G. Suppressors shall be installed in a manner that allows simple replacement within short periods of downtime.
- H. Suppressors other than point of use type and those for exterior lighting poles shall be installed with a means of disconnecting the suppressor at the panel. At the main service entrance location, provide a dedicated 60 amp, 3P-breaker for the TVSS device. At the distribution secondary and/or subpanels location, provide dedicated 30 amp, 3P-CB, for the TVSS device. Label disconnect or CB "Surge Protector". Fused disconnects may be substituted for the CB, with the approval of the engineer. Change rating of CB's noted above as required to properly provide system as recommended by manufacturer.
- I. Install surge suppression equipment per manufacturer's recommendation at each wire terminal as noted under Part 1.
- J. Install in surge suppression equipment terminal cabinets, etc. as required to facilitate installation of surge protection equipment and terminal points. Increase size of terminal cabinets (from that shown on drawings) to size required to facilitate installation of surge suppression equipment and terminal blocks.

3.4 GROUND INSTALLATION

A. Ground Bus Connections:

1. Provide “local” ground bus in each terminal cabinet housing surge protection equipment (with lugs, etc. as required).
2. Bond “local” ground bus to terminal cabinet with minimum #6 copper wire.
3. Connect terminal cabinet “local” ground bus to “system” ground bus installed per 260526 with minimum #6 copper insulated wire (unless otherwise noted) in conduit.

B. Surge Suppression Equipment Grounding:

1. Connect each surge suppressor to local ground bus in terminal cabinet with wire sized as recommended by manufacturer. Where “M” block type terminations/surge suppressors are used, bond ground rail to local ground bar with wire as recommended by manufacturer.
2. Assure that 120VAC power source/supply surge suppressor is also grounded to same local ground bus as surge suppressors provided in this section for same system (i.e. fire alarm, intercom, television, etc.).

C. Conductors:

1. Conductors shall meet requirements of Section 260519. Minimum size to be #8 THWN and shall be twisted together a minimum of three turns per inch.
2. Bends in excess of 90 degrees in any grounding conductor shall not be permitted. A radius of 6 inches or greater shall be maintained on all bends.
3. Do not bundle unprotected conductors with protected conductors.
4. Conductors shall be kept as short and straight as possible.
5. Conductors shall be secured at 12” intervals with an approved copper clamp.
6. Grounding conductors shall be properly connected to the building service ground by approved clamps.

D. Grounding Connectors:

1. Connectors, splicers, and other fittings used to interconnect grounding conductors, bond to equipment or grounding bars, shall be approved by NEC or U.L. for the purpose.
2. All connectors and fittings shall be of the Nicopress crimp or compression set screw type.
3. Special treatment to fittings, lugs, or other connectors of dissimilar material shall be applied to prevent electro-galvanic action.

3.5 TELEPHONE CIRCUITS

- A. Systems utilizing telephone company pairs as a transmission medium shall be provided with suppressor conforming to respective device in Part 2 of this specification.
- B. Suppressors shall be installed at each point where interface is made to telephone company pairs.
- C. In cases where a modem or other device is used to interface with the telephone circuit the following procedure shall apply:
1. Where the modem or coupling device is furnished by the telephone company the suppressors shall be installed on the system side of the modem or coupling device.
 2. Where the modem or coupling device is furnished by the system contractor, the suppressor shall be installed on the telephone line side of the modem or coupling device.

3.6 PLACING SYSTEM INTO SERVICE

- A. Do not energize or connect service entrance equipment or panelboards to their sources until surge protection devices are installed and connected.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust equipment installation, including connections and to assist in field testing. Report results in writing.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

- D. Testing: Perform the following field tests and inspections and prepare test reports:

1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with manufacturer's instructions.
2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

E. Remove and replace malfunctioning units and retest as specified above.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Department's maintenance personnel to adjust, operate, and maintain transient voltage suppression devices.

END OF SECTION 264313

SECTION 265113 - INTERIOR LIGHTING FIXTURES, LAMPS AND BALLASTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories
- B. Emergency lighting units
- C. Exit signs
- D. Ballasts
- E. Fluorescent lamp emergency power supply
- F. Lamps
- G. Luminaire accessories

1.2 REFERENCES

- A. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns
- B. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications
- C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type)
- D. NEMA WD 6 - Wiring Devices-Dimensional Requirements
- E. NFPA 70 - National Electrical Code
- F. NFPA 101 - Life Safety Code

1.3 SUBMITTALS FOR REVIEW

- A. Section 260501 - Submittals: Procedures for submittals.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

1.4 SUBMITTALS FOR INFORMATION

- A. Section 260501 - Submittals: Submittals for information.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Submittals for project closeout.
- B. Submit manufacturer's operation and maintenance instructions for each product.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Furnish Products as scheduled.

2.2 EMERGENCY LIGHTING UNITS

- A. Furnish products as scheduled.
- B. Description: Self-contained emergency lighting unit.
- C. Battery: 12 volt, with 1.5 hour capacity.
- D. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- E. Indicators: Lamps to indicate AC ON and RECHARGING.
- F. TEST switch: Transfers unit from external power supply to integral battery supply.
- G. Electrical Connection: Connection shall be hardwired via conduit (cord and plug connection shall not be allowed).

2.3 EXIT SIGNS

- A. Furnish products as scheduled.
- B. Description: Exit sign fixture suitable for use as emergency lighting unit.
- C. Battery: 12 volt, nickel-calcium, lead calcium type, with 1.5 hour capacity.

- D. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- E. Indicators: Lamps to indicate AC ON and RECHARGING.
- F. TEST switch: Transfers unit from external power supply to integral battery supply.
- G. Lamps: Manufacturers standard LED.
- H. Electrical Connection: Connection shall be hardwired via conduit (cord and plug connection shall not be allowed).

2.4 FLUORESCENT BALLASTS

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)
 - 1. Advanced
 - 2. Bodine
 - 3. Sylvania/Osram
- B. Description: ANSI C82.2, high power factor type, sound rated (group A), instant start electronic type ballast with passive power factor correction, active power factor correction is not acceptable. Ballasts shall not have more than 10% total harmonic distortion (THD) of the current. Ballasts with high line starting current (greater than 125% of operating current) are not acceptable. Ballasts shall be suitable for lamps specified.
- C. Exterior ballasts shall meet requirements specified above and shall operate properly in cold weather. The minimum lamp starting temperature shall be 0° F.
- D. Voltage: Match luminaire voltage.
- E. Source Quality Control: Certify fluorescent ballast design and construction by Certified Ballast Manufacturers, Inc.
- F. Provide all magnetic ballasts with in-line fuse protection.

2.5 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)
 - 1. Advance
 - 2. Universal
 - 3. Sylvania/Osram

- B. Description: ANSI C82.4, mercury vapor, metal halide or high pressure sodium lamp ballast, suitable for lamp specified. Ballast shall be constant wattage high power factor encapsulated type with multi-type line connections for 120, 208, 277, and 480 volts.
- C. Exterior ballasts shall meet requirements specified above and shall be for reliable starting to -20°F.
- D. Voltage: Match luminaire voltage.
- E. All ballasts shall have been provided with in-line fuse protection.

2.6 FLUORESCENT LAMP EMERGENCY POWER SUPPLY

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)
 - 1. Bodine
 - 2. Chloride
 - 3. Light alarms
- B. Description: Emergency battery power supply suitable for installation in ballast compartment of fluorescent luminaire.
- C. Lamp Ratings: (2) two F32T8 lamp providing 1400 lumens, minimum.
- D. Battery: Sealed lead calcium type, rated for 10 year life.
- E. Include TEST switch and AC ON indicator light, installed to be operable and visible from the outside of an assembled luminaire.

2.7 LAMPS

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)
 - 1. Sylvania/Osram
 - 2. General Electric (unless indicated otherwise on the drawings).
- B. Lamp Types: As specified for luminaire.
- C. Fluorescent lamp color temperature shall be 3500 degrees Kelvin with a minimum CRI of 82.
- D. Low temperature lamps and ballasts shall be provided for all exterior applications.

- E. Reflector Lamp Beam Patterns: ANSI C78.379.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install suspended luminaires using pendants. Provide pendant length required to suspend luminaire at the indicated height in the fixture schedule.
- B. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- C. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- D. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- E. Install recessed luminaires to permit removal from below.
- F. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- G. Install seismic clips to secure the luminaires to the ceiling grid.
- H. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on Drawings, as scheduled.
- I. Provide thermal protection for all recessed incandescent fixtures.
- J. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within the luminaire.
- K. Bond products and metal accessories to the branch circuit equipment grounding conductor.
- L. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.
- M. Connect battery operated emergency light fixtures to local lighting circuit ahead of all switches. Provide and install all wiring as required for proper operation.
- N. Where ceiling mounted fixtures are called for in the Light Fixtures Schedule and on the drawings, this Contractor shall provide fixture trims and supports as required to match the type of ceiling system being furnished. Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Clips identified

for use with the type of ceiling framing member(s) and fixture(s) shall also be permitted.

- O. In addition to attaching ceiling mounted lighting fixtures to ceiling system, this contractor shall support lay-in type fixtures to superstructure above by means of 12-gauge safety wire or jack chain. Safety wire shall be attached to from each corner of fixture and be connected directly to building structure. Surface mounted fixtures and/or ceiling boxes shall be supported to superstructure with all-thread rod.
- P. Light fixtures shall not have any labels exposed to normal viewing angles. This includes manufacturer labels and U.L. labels.
- Q. Provide dimming ballasts (dimmable down to 5% of light output) for all fluorescent lights connected to dimming circuits as required to match the dimmer unit/system.
- R. Provide low voltage transformers and power supplies for all low voltage light fixtures.
- S. Tents as required for fixtures in fire rated ceilings as per applicable codes.
- T. Thermal protection for all fixtures with tents or fixtures surrounded by insulation.
- U. Ceiling surface mounted fluorescent fixtures installed in exposed ceiling areas are to suspended from ceiling structure with minimum 3/8" all-thread rods and 1-1/2" x 1-1/2" Kindorf channels, full length of fixture/row. Mount outlet box at structure with flexible connection to fixture.
- V. Coordinate fixtures installed in mechanical rooms with piping and ductwork prior to installation and relocate fixtures as required to provide proper illumination and future access to the fixture for maintenance.
- W. Locate all remote ballasts in well ventilated and accessible spaces.

3.2 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connections and operation.

3.3 ADJUSTING

- A. Contract Closeout
- B. Aim and adjust luminaires as indicated.

- C. Position exit sign directional arrows as indicated.

3.4 CLEANING

- A. Contract Closeout: Cleaning installed work.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from inside the enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damaged paint.

3.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate luminaire operation for minimum of two hours.

3.6 PROTECTION OF FINISHED WORK

- A. Relamp any luminaires that have failed lamps at Substantial Completion.

END OF SECTION 265113

SECTION 265629 - SITE LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaires and accessories
- B. Poles

1.2 RELATED SECTIONS

- A. Cast-in-Place Concrete: Foundations for poles.

1.3 REFERENCES

- A. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns
- B. ANSI C82.1 - Ballasts for Fluorescent Lamps-Specifications
- C. ANSI C82.4 - Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type)
- D. ANSI O5.1 - Specifications and Dimensions for Wood Poles
- E. IES RP-8 - Recommended Practice for Roadway Lighting
- F. IES RP-20 - Lighting for Parking Facilities
- G. NFPA 70 - National Electrical Code

1.4 SUBMITTALS FOR REVIEW

- A. Section 260501 - Submittals: Procedures for submittals.
- B. Shop Drawings: Indicate dimensions and components for each luminaire which is not a standard Product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 260501 - Submittals: Submittals for information.
- B. Test Reports: Indicate measured illumination levels.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout: Submittals for project closeout.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 260500 - Material and Equipment: Transport, handle, store, and protect products.
- B. Store and handle solid wood poles in accordance with ANSI O5.1.

1.9 COORDINATION

- A. Furnish bolt templates and pole mounting accessories to installer of pole foundations.
- B. Coordinate the site lighting locations with the Civil plans and the Landscape plans before roughing in concrete pole bases for pole lights.

PART 2 - PRODUCTS

2.1 LUMINAIRES AND ACCESSORIES

- A. Furnish Products as scheduled. Refer to Section 260502 for substitutions and product options.
- B. Building mounted light fixtures will be listed as vandal resistant type.

2.2 FLUORESCENT BALLASTS

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)
 - 1. Magnetek
 - 2. Universal
 - 3. General Electric
- B. Description: ANSI C82.2, high power factor type, sound rated (group A), instant start electronic type ballast with passive power factor correction, active power factor correction is not acceptable. Ballasts shall not have less than 10% harmonic distortion nor more than 10% total harmonic distortion. Ballasts with

high line starting current (greater than 125% of operating current) are not acceptable. Ballasts shall be suitable for lamps specified.

- C. Exterior ballasts shall meet requirements specified above and shall be for reliable starting to 0°F.
- D. Voltage: Match luminaire voltage.
- E. Source Quality Control: Certify fluorescent ballast design and construction by Certified Ballast Manufacturers, Inc.
- F. All magnetic ballasts shall be provided with in-line fuse protection.

2.3 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. Manufacturers: (any product that meets or exceeds the performance or quality of the following manufacturers will be considered.)
 - 1. Magnetek
 - 2. Universal
 - 3. General Electric
- B. Description: ANSI C82.4, mercury vapor, metal halide or high pressure sodium lamp ballast, suitable for lamp specified. Ballast shall be constant wattage high power factor encapsulated type with multi-type line connections for 120, 208, 277, and 480 volts.
- C. Exterior ballasts shall meet requirements specified above and shall be for reliable starting to -20°F.
- D. Voltage: Match luminaire voltage.
- E. All magnetic ballasts shall be provided with in-line fuse protection.

2.4 LAMPS

- A. Refer to Section 265113

2.5 POLES

- A. Manufacturers: Match specified fixture provide as scheduled with following accessories.
- B. Base: Breakaway, No breakaway, Transformer type.
- C. Accessories:

1. Hand hole
2. Anchor bolts
3. Anchor bolt base cover
4. Provide properly rated poles. The total weight of the light fixtures and the effective projected area (EPA), with a 1.3 gust, of the light fixture assembly shall not exceed the rating of the pole(s) at a given wind velocity. The wind velocity for the job site shall be selected from the Florida Building Code wind speed map.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide concrete bases for the lighting poles at locations indicated on the plans.
- B. Install poles plumb. Provide double nuts to adjust plumb. Grout around each base.
- C. Install lamps in each luminaire.
- D. Bond luminaires metal accessories and/or metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole (5/8" x 10' ground rod).

3.2 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- B. Measure illumination levels to verify conformance with performance requirements.
- C. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.3 ADJUSTING

- A. Contract Closeout
- B. Aim and adjust luminaires to provide illumination levels and distribution indicated on Drawings as directed.

3.4 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosure.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.5 PROTECTION OF FINISHED WORK

A. Contract Closeout: Protecting installed work.

B. Relamp luminaires which have failed lamps at Substantial Completion.

END OF SECTION 265629

SECTION 265630 – EXTERIOR LIGHTING CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Lighting contactors
- B. Photocells
- C. Solid state flashers, and Power line RFI filters.
- D. Selector switches and Indicating Lights
- E. Enclosures
- F. Secondary surge arresters
- G. Furnish and install a complete control panel for control of the flashing yellow traffic barrier signal lights, with separate control switch for lights under the gantry canopy and the roadway lights in the vicinity of the toll plaza.

1.2 REFERENCES

- A. UL 508A - Industrial Control Panels
- B. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- C. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies
- D. NFPA 70 - National Electrical Code

1.3 SUBMITTALS

- A. Section 260501 – Shop Drawing Requirements
- B. Shop Drawings: Submit dimensioned drawings of the lighting control panel and accessories including, but not necessarily limited to, the enclosure, lighting contactors, terminal strips, selector switches, indicating lights, photocells, solid state flashers, power line filters, secondary surge arresters, and name plates. Drawings to indicate exact location of each device.
- C. Product Data: Submit for approval 6 copies of manufacturer's data on the specific lighting control system and components. Submit a complete bill of materials with part numbers, description and voltage specifications.

- D. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component. Submittals that show typical riser diagrams are not acceptable.

1.4 QUALITY ASSURANCE

- A. Control wiring shall be in accordance with the NEC requirements for Class 1 wiring, Article 725 and the manufacturer specification.
- B. Lighting control panels shall be listed to UL 508A industrial Control Panels.

1.5 MAINTENANCE MATERIALS

- A. Provide 4 spare relays per lighting contactor.
- B. Provide operating manuals and schematics.

PART 2 - PRODUCTS

2.1 MATERIAL AND COMPONENTS

- A. Lighting Control Panels: Panels shall be made up of the following components:
 - 1. NEMA rated enclosure with a hinged door. Rain tight or oil tight and other NEMA rated versions available.
- B. Standard Output Relays
 - 1. Mechanically held, electrically operated lighting contactor with 30 Amp, 480 VAC rated contacts. Rated for use with HID lights.
 - 2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #10AWG wires on both the line and the load side. Systems that do not allow for individual relay replacement or additions are not acceptable.
 - 3. Rated at 30 Amp, 480VAC Ballast.
 - 4. Relays to be rated for 250,000 operations minimum at 20a lighting load, use Zero Cross circuitry and be Normally Closed (NCZC). All incandescent circuits shall be energized by use of a Normally Closed SoftStart™ (NCSS) relay rated at 100,000 operations at full 20a load. No exceptions.
- C. DTC - Digital Electronic Time Clock

1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept interface inputs.
 2. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.
 3. The DTC shall be run from non-volatile memory so that all system programming and real time clock functions are maintained for a minimum of 15 years with loss of power.
 4. DTC shall provide system wide timed overrides. Any relay, group or zoned that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.
- D. Interfaces: For future expansion capability, system to have available all of the following interfaces. Verify and install only those interfaces indicated on the plans.
1. A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card.
 2. An exterior (PCO) or interior (PCI) photocell that provides readout on the DTC screen in number values analogous to foot-candles. Each photocell shall provide a minimum of 14 trigger points. Each trigger can be programmed to control any relay or zone. Each trigger shall be set through programming only. Photocells which requires the use of setscrews or which must be programmed at the photocell control card shall be not acceptable.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Mount relay control cabinets adjacent to respective lighting panelboard. Cabinet shall be surface or flush mount, per plans. Wiring between relay control cabinet and panelboards to be per local codes and acceptable industry standards. Neatly lace and rack wiring in cabinets. During construction process, protect all interior components of each relay panel and each digital switch from dust and debris.
- B. Wiring
1. Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.

2. Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.
3. Neatly lace and rack wiring in cabinets.
4. Surge Protection Devices shall not be mounted inside lighting control cabinets.

3.2 DOCUMENTATION

- A. Each relay shall have an identification label indicating the originating branch circuit number and panelboard name along with the relay number as indicated on the drawings. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.
- B. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the identification number for that relay, placement of switches and location of photocell. Original to be given to owner, copies placed inside the door of each LCP.

3.3 CLEANING

- A. Remove dirt and debris from all LCP enclosures.
- B. Clean photocell lens as recommended by manufacturer.
- C. Clean all switch faceplates.

END OF SECTION 265630

SECTION 271301 - VOICE / DATA SERVICE, PATHWAYS, AND WIRING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Telephone and data service entrance raceways
- B. Equipment and terminal backboards
- C. Telephone cabinets
- D. Premises wiring and outlets
- E. Pathways

1.2 RELATED SECTIONS

- A. Section 260533 – Raceways and Boxes for Electrical Systems

1.3 REFERENCES

- A. EIA/TIA-568 - Commercial Building Wiring Standard
- B. EIA/TIA-569 - Commercial Building Standard for Telecommunication Pathways and Spaces
- C. NFPA 70 - National Electrical Code

1.4 SYSTEM DESCRIPTION

- A. Service Entrance Pathway: Rigid steel conduit and nonmetallic conduit from point of connection shown to building service termination cabinet.
- B. Backbone Pathway: Conform to EIA/TIA 569 using conduit, sleeves, slots as indicated.
- C. Horizontal Pathway: Conform to EIA/TIA 569, using raceway, backboards, and cabinets as indicated.
- D. Premises Wiring: Complete from telephone terminal backboard and data service racks to each outlet, using wire and cable as specified.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations and sizes of pathways and outlets.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with EIA/TIA 569.
- B. Testing. Test each Data cable for Length, Attenuation, and Near end cross talk. Record the test data for each cable and submit one copy to the Engineer with the As-Built / Record documents.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in installing premises pathways with minimum three years experience.

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish Products listed and classified by Underwriters Laboratories, Inc. and acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of premises wiring for one year from Date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Provide four jacks and plates of each type.

PART 2 - PRODUCTS

2.1 TELEPHONE TERMINATION BACKBOARDS

- A. Material: Interior BC plywood, Type "A" fire-retardant-treated plywood with a flame spread of 25 or less.
- B. Size: 4 x 8 feet (1.2 x 2.4 m), ¾ inch (19 mm) thick.
- C. Finish: Gray paint having a fire spread rating of Class C as a minimum.

2.2 VOICE / DATA WIRE, CABLE AND JACKS

- A. Cable: Cat 5e, 4 Unshielded Twisted Pairs of 24 AWG solid copper conductors. For use up to 350 MHz.
- B. Modular Plates / Jacks
 - 1. Voice RJ-11
 - 2. Data RJ-45
- C. Terminal Blocks: Cat 5e 110 terminal blocks

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wire and cable in accordance with manufacturer's instructions and in accordance with EIA/TIA 568.
- B. Finish paint both sides of the termination backboards with two coats of durable fire retardant gray paint.
- C. Install termination cabinets plumb, and attach securely to building wall at each corner. Install cabinet trim plumb.
- D. Install recessed cabinets flush with wall finishes, and stub 5 empty 1 inch (25 mm) conduits to accessible location above ceiling, below floor at each location.
- E. Install pullwire, polyethylene pulling string in each empty conduit over ten feet in length or containing a bend.
- F. Mark all backboard and cabinets with the legend under the provisions of Section 260553.
- G. Label both ends of each communications cable with the Room #. The Room number is the room in which the voice/data outlet box is located. When more than one cable is terminated in the room, an A, B, C, etc.. shall be included after the Room number. i.e. 207B, 207C, etc... The label maker and labels shall be equal to Panduit Thermal Transfer Printer with #S050X150VAC vinyl self-laminating labels.
- H. Provide typed labels on each faceplate showing the address of each voice and/or data outlet. A four port faceplate shall employ four labels with separate unique addresses for each outlet.

END OF SECTION 271301

SECTION 271302 – RADIO SYSTEM PATHWAYS AND WIRING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Backboards, terminal cabinets, raceways, outlet boxes, and wiring

1.2 SUBMITTALS

- A. All material used in this section, and not submitted under another section, shall be submitted for approval

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Radios will be furnished by Toll Operations and installed by the Contractor.
- B. Wall outlets shall be four inch (4") square outlet boxes with single gang raised plaster ring cover and device plate and outlet connector.
- C. Device plates shall be stainless steel, each with a single bushed hole.
- D. Provide bushings on all conduits.
- E. Provide all radio cabling. Install all cabling in conduit.
- F. Grounding conductors shall be #6 bare copper unless indicated otherwise.
- G. Provide all start-up and testing of radio system extension.

2.2 WIRING

- A. Three pair 22 AWG with individual shields for each pair and common jacket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all conduits in a manner conforming to the requirements outlined in the Raceway Section of this specification.
- B. Neatly rack conduits at terminal board location on a Unistrut Type rack secured to wall above and below terminal boards.

END OF SECTION 271302

SECTION 274134 - CLOSED CIRCUIT TELEVISION PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Closed circuit television systems raceway
- B. Closed circuit television

1.2 RELATED SECTIONS

- A. Section 260533 – Raceways and Boxes for Electrical Systems

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code

1.4 SYSTEM DESCRIPTION

- A. Backbone Pathway: Conform to EIA/TIA 569 using conduit, sleeves, slots as indicated.
- B. Horizontal Pathway: Conform to EIA/TIA 569, using raceway, backboards, and cabinets as indicated.
- C. Wiring: By Owner.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations and sizes of pathways and outlets.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with Owner's closed circuit television vendor's rules and regulations.

PART 2 - PRODUCTS

2.1 CLOSED CIRCUIT TELEVISION SYSTEMS TERMINATION CABINETS

- A. Manufacturers: (any product that meets or exceeds the performance and quality of the following manufacturers will be considered.)
 - 1. Hoffman
 - 2. Square D

- B. Cabinet Boxes: Galvanized steel with removable endwalls, 24 inches (61 mm) wide, 6 inches (15 mm) deep. Provide plywood backboard inside cabinet for mounting telephone termination devices.
- C. Cabinet Fronts: Steel, flush, surface type with concealed trim clamps, screw cover front, concealed hinge, double doors, and flush lock keyed to match branch circuit panelboard.
- D. Finish: Gray baked enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Finish paint both sides of termination backboards with two coats of durable fire retardant gray paint under the provisions of Section 099123 prior to installation of telephone equipment..
- B. Support raceways, backboards, and cabinets under the provisions of Section 260529.
- C. Install termination backboards and cabinets plumb, and attach securely to building wall at each corner. Install cabinet trim plumb.
- D. Install recessed cabinets flush with wall finishes, and stub 5 empty 1 inch (25 mm) conduits to accessible location above ceiling and below floor at each location.
- E. Install polyethylene pulling string in each empty closed circuit television conduit over ten feet in length or containing a bend.
- F. Mark all backboards and cabinets with the legend "CCTV" under the provisions of Section 260553.

END OF SECTION 274134

SECTION 275124 – INTERCOM SYSTEM PATHWAYS AND WIRING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Backboards, terminal cabinets, raceways, outlet boxes, and wiring

1.2 SUBMITTALS

- A. All material used in this section, and not submitted under another section, shall be submitted for approval

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Furnish and install intercom.
- B. Wall outlets shall be four inch (4") square outlet boxes with single gang raised plaster ring cover and device plate and outlet connector.
- C. Device plates shall be stainless steel, each with a single bushed hole.
- D. Bushings shall be provided on all conduits.
- E. Provide all intercom cabling. All cabling shall be installed in conduit.
- F. Grounding conductors shall be #6 bare copper unless indicated otherwise.
- G. Provide all start-up and testing of radio system extension.

2.2 WIRING

- A. Three pair 22 AWG with individual shields for each pair and common jacket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All conduits shall be installed in a manner conforming to the requirements outlined in the Raceway Section of this specification.
- B. Conduits at terminal board location shall be neatly racked on a Unistrut Type rack secured to wall above and below terminal boards.

END OF SECTION 275124

SECTION 280514 – INTRUSION DETECTION, AND SECURITY ACCESS SYSTEM AND PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Security access devices
- B. Terminal cabinets and raceways
- C. Access control panel

1.2 RELATED SECTIONS

- A. Section 260533 – Raceways and Boxes for Electrical Systems
- B. Section 260519 – Low Voltage Electrical Power Conductors and Cables

1.3 REFERENCES

- A. EIA/TIA-568 - Commercial Building Wiring Standard
- B. EIA/TIA-569 - Commercial Building Standard for Telecommunication Pathways and Spaces
- C. NFPA 70 – Current version
- D. NFPA 101 – Life Safety
- E. NFPA 731 – Security System Installation
- F. All power supplies shall be UL listed and have a UL label on them.
- G. UL 294 Listed
- H. UL 365 Listed
- I. UL 309 Listed
- J. UL 1610 Listed
- K. UL 1635 Listed

1.4 SYSTEM DESCRIPTION

- A. The intrusion detection and security access system shall consist of an integrated system with centralized control and management capable of standalone operations during communications failure, a complete system with Central Processing Unit (CPU), battery backup, Video Display Terminal programmer (VDT), printer, keyboard, and Smart Terminal Interfaces operating on a dedicated electronic data transmission network supporting card readers and door contacts.
- B. System software shall be provided with the intrusion detection and security access system. System license shall be for the entire system and shall include capability for future additions.
- C. The intrusion detection and security access system shall control and monitor certain doors, manager's cash locker, vault, depository, and elevators.

1.5 SYSTEM PERFORMANCE

- A. The Security and Card Access system shall consist of a P2000 host computer and related optional equipment, its accessories and peripheral equipment. The accessories shall consist of display terminals and printers. The peripheral equipment shall consist of all the components connected to the P2000 host computer that performs access control functions, monitors alarms, and operate output controls, as well as equipment used to distribute or transmit data/control information to and from peripherals.
- B. To obtain access, a card holder shall use his card at the card reader of the access module. Card data shall be sent to a terminal interface unit that shall interpret card data and communicate it to the central controller where it will be compared with the data in the system files. When an authorized entry attempt is determined, the central controller shall grant access by sending a signal to the terminal interface unit to unlock an access restriction device. When an unauthorized entry attempt is determined, the access point shall remain secure.
- C. The system shall provide an access control report by employee card number, time, and location of access. When an alarm occurs, the VDT shall alert the operator to take appropriate action. The system shall maintain a permanent record of alarms and all card activity. Hard copy printouts of reports shall be available on demand.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit "record" drawings to the engineer.
- B. Record actual locations and sizes of the pathways and outlets.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with EIA/TIA-569.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in installing the products specified in this section with minimum three years experience.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish Products listed and classified by Underwriters Laboratories, Inc. and acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of the Intrusion Detection and Security Access System for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SUPPLIERS/MANUFACTURERS

- A. The manufacturer(s) shall have a local office facility and be able to provide service within four (4) hours on a twenty-four (24) hour basis. Equipment shall be UL listed. Only the firm listed below is approved for use. No substitutions will be permitted. (Due to system compatibility issues this is the only acceptable product).

- 1. Johnson Controls.

2.2 INTRUSION DETECTION AND SECURITY ACCESS SYSTEM

- A. CPU: Johnson Controls P2000LE with CCTV and Video Imaging
- B. Controller: CK – 722 or CK-721A as needed
- C. Printer: Compaq LA450 with H8571-C Adapter
- D. Multi-Terminal Interface: Card Key MTI-1
- E. Smart Terminal Interface:

1. Card Key DSTI-SI (double)
 2. Card Key STI-SB-C2 (single)
- F. Smart Terminal Power Supply: Altronix AL300ULM
- G. Electric Door Strike: Von Duprin or equal
- H. Door Contacts: Sentrol 1078-C
- I. Card Readers:
1. HID, iClass R10 card reader
- J. Key Bypass (front door admin): SDC 800N
- K. Request to exit Passive Infrared Detector: Bosh DS161

2.3 TERMINAL CABINETS

- A. Cabinet Boxes; Galvanized steel, 24 by 24 inches (61 mm), 6 inches (15 mm) deep. Provide plywood backboard inside cabinet for mounting telephone termination devices.
- B. Cabinet Fronts: Steel, flush, surface type with concealed trim clamps, screw cover front, concealed hinge, double doors, and flush lock keyed to match branch circuit panelboard.
- C. Finish: Gray baked enamel.

2.4 SYSTEM WIRE AND CABLE

- A. Power Branch Circuits: 12 AWG THWN building wire as specified in Section 260519
- B. Smart Terminal Interface Circuits: Belden 8723
- C. Electric Door Strike: Belden 8760
- D. Request to Exit PIR Circuits: Belden 8451
- E. Card Reader Circuits: Belden 8771
- F. Keyboard Circuits: Alpha 5198
- G. Shunt Circuits: 16 AWG THWN building wire as specified in Section 260519

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install conduit, wireways, and pathways in accordance with manufacturer's instructions and in accordance with EIA/TIA 568 and Section 260533.
- B. Install termination cabinets plumb, and attach securely to building wall at each corner. Install cabinet trim plumb.
- C. Install pullwire, polyethylene pulling string in each empty conduit over ten feet in length or containing a bend.
- D. Mark all backboard and cabinets with the legend under the provisions of Section 260553.
- E. Install in accordance with manufacturer's instructions.

3.2 TRAINING

- A. Contractor shall provide a minimum of two 2-hour training seminars, on site, to instruct the owner's personnel in the proper use of the system and its features.
- B. The owner will advise contractor of the dates and times of the seminars.

END OF SECTION 280514